

## **APPENDIX D2:**

### **SELECTED RESPONSES**

The department has analyzed all the comments received on the proposed rule in detail and responses to these comments by category or subject matter are given in Part 1 of this Appendix. The CES narrative also addresses many of the comments in that many of the broader issues raised in the comments are responded to in the narrative. Part 2 of this Appendix provides summary responses to some selected individual comments that were more comprehensive or that the department considered to be particularly representative. Appendix D2 includes the following responses:

Response to Comments by AWB and WECARE	p. D2-01
Response to Comments by UPS	p. D2-21
Response to Comments by Rodney Smith (Freeborn and Peters)	p. D2-56
Response to Comments by AGC of Washington and Inland Northwest AGC	p. D2-72
Response to Comments by Washington State Farm Bureau	p. D2-77
Response to Comments by the Pacific Maritime Association (PMA) and Jones Stevedoring Company	p. D2-80
Response to Comments by National Federation of Independent Business	p. D2-84
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Response to Comments by Northwest Food Processors Association and Snokist Growers	p. D2-89
Response to Comments by Association of Washington Cities	p. D2-92

**Response to Comments by Association of Washington Business (AWB) And  
Washington Employers Concerned About Regulation Of Ergonomics (WE CARE):  
Summary**

The department has analyzed and responded fully to the comments by AWB and WE CARE and the attachments to these comments. The AWB and WE CARE comments are virtually identical and are here considered together. The department response may be found in three places: this summary and its attachments, the CES narrative and Appendix D to the CES. This summary follows the sequence of the AWB and WE CARE comments.

This summary is accompanied by two attachments:

Attachment 1: Response to the Occulink Report to WE CARE

Attachment 2: Response to the M. Cubed Report to AWB

1. *L&I Exceeds Rulemaking Authority*

Contrary to the assertions in the comments, L&I does have statutory authority to adopt this rule. This authority is discussed thoroughly in the CES narrative. The comments mistakenly charge that the CR-102 states that the department relies solely on RCW 49.17.010 for this rulemaking. In fact the CR-102 explicitly refers to RCW 49.17.010, .040, and .050.

2. *Failure to Comply With the Administrative Procedures Act*

The department has carefully addressed every requirement of the APA in this rulemaking. Each element of the APA is discussed in the CES narrative and CES Appendix E. In particular, the department has considered and rejected specific and general alternatives to rulemaking and has analyzed and explained why the rule is the least burdensome alternative for those required to comply. It has considered and rejected pilot rulemaking, negotiated rulemaking, reliance on voluntary assistance and workers' compensation incentives.

The department fully considered input from the public rule development meetings, the advisory committee process, and comments provided during and following the rulemaking hearings. Documents from the advisory committee process that are in the rulemaking file demonstrate that the department presented and discussed numerous alternatives to rulemaking and alternative formulations of a rule with the committees. It is not true that the department failed to act on an advisory committee recommendation not to pursue rule promulgation. The advisory committee made no such recommendation and AWB/WE CARE provides no evidence that it did. Several individual members of the advisory committee did recommend that the department stop the rulemaking, while others supported rulemaking. AWB, however, has recommended to L&I for several years that rulemaking is a proper way to address ergonomics. In a 12/15/95 letter on L&I's proposed ergonomics policy Clif Finch

and Amber Balch of AWB wrote to Kevin Simonton of L&I “The Washington State Administrative Procedure Act provides clear guidance that rulemaking is required.” In a 7/26/96 letter to Kevin Simonton from Clif Finch, AWB stated “The Washington State Administrative Procedure Act, a statutory legislative preference and common fairness demand that rulemaking should be utilized for this standard.” Finally, on 7/29/98 the AWB publication *Washington Business* stated in a front-page article “The department will put the issue of ergonomics before the public through the rulemaking process. ‘This is a victory for Washington’s employers’ AWB’s regulatory reform manager Amber Balch said.”

3. *Lack of Recognized Hazards. Injuries are Declining*

WMSD rates have declined during the 1990’s in the absence of a rule and AWB/WE CARE have suggested that a rule is therefore unnecessary. L&I notes, however, that while the rate of all workers’ compensation claims has been declining during the 1990’s the rate for WMSDs has declined more slowly and the proportion of all claims represented by WMSDs has increased. Moreover, the rate of decline in WMSDs has slowed considerably in the past few years and in several important industry groups and for some types of WMSDs the rates have flattened completely or actually increased. Thus, despite some positive trends, the pace of improvement has slowed and WMSDs still account for unacceptably high numbers of claims and very high claim costs. L&I seeks sustained or increased improvement rather than a continuation of recent trends and believes that this is not possible without the additional stimulation provided by a rule, particularly with regard to those employers who are most resistant to voluntary approaches. The CES narrative has a more detailed discussion of this subject, including why the department has concluded that the rule will be more effective in reducing WMSDs than the various alternatives.

AWB/WE CARE suggest that the implementation of a rule may actually increase the incidence of WMSDs because of the utilization of unproven technologies or the use of a prescriptive approach with unclear requirements. The rule, however, requires that known hazards be reduced to the degree feasible and does not require the use of any unproven technologies to do this. The rule also has very clear requirements that well-defined hazards be identified and reduced, but it provides substantial flexibility regarding the choice of methods used by employers to achieve this reduction.

AWB/WE CARE state that a rule “with its establishment of a standard of care, would be a disservice to the justice system.” L&I believes that the U.S. Congress and Washington State Legislature gave due consideration to the consequences of granting OSHA and L&I rulemaking authority. L&I believes that the rule is supported by adequate, objective scientific and medical evidence and meets all the tests required.

4. *Insufficient Scientific and Medical Data*

AWB/WE CARE comment that a lack of scientific consensus on various basic questions and a lack of sound evidence on cause and effect “undermines WISHA’s

proposal.” The comments state that NIOSH (Bernard 1997) determined that there is insufficient evidence to establish causality and that because the evidence is still incomplete L&I must “address this deficiency prior to issuing a final rule.” L&I disagrees with this characterization of the NIOSH review. Dr. Linda Rosenstock, Director of NIOSH, testified strongly in support of the rule, stating that “The bottom line is that we know enough now to prevent or reduce the severity of many of these disorders, and the Washington State Proposed Ergonomics rule is an effective and scientifically valid way to do so.” L&I has conducted an extensive review of the scientific literature and believes that the best available evidence provides strong and compelling evidence supporting this rule. L&I believes that consensus is not required for rulemaking. The CES narrative provides a detailed discussion of the scientific evidence for this rule.

The comments state that L&I must provide evidence that the rule requirements are verified by practical experience and are capable of being implemented by businesses of all sizes. L&I provides this evidence in the CES, the technological feasibility assessment and the cost-benefit analysis.

The comments state that L&I’s “approach trivializes the role of nonwork-related risk factors.” L&I agrees that MSDs can be caused by non-work factors, including psychosocial factors, and discusses this matter in the CES. However, the validity of an occupational safety and health rule is not reduced by these non-work relationships. The CES provides ample evidence that WMSDs are serious ailments resulting in material impairment to health and functional capacity; that high numbers and rates of WMSDs constitute a major problem in Washington workplaces; that the presence of hazards at work pose substantial and widespread risks; and that ergonomics provides effective ways to reduce or eliminate these risks. Non-work risk factors do not contradict the findings of work relatedness and do not reduce the importance of reducing the workplace hazards where they exist.

The comments state that there is inadequate evidence of specific relationships between occupational risk factors and the occurrence of WMSDs. L&I believes there is extensive evidence of exposure-response relationships that provides an adequate basis for rulemaking and presents this evidence in the CES narrative. AWB/WE CARE state that L&I bases its conclusions on “subjective observation, anecdotal evidence and opinions.” The comments offer no specific evidence for this incorrect belief. The CES narrative provides discussion of well-designed, peer reviewed and published scientific studies in support of each of the risk factors regulated. Some of the most important are summarized in Tables 7 and 8. Appendix B provides figures illustrating relationships between exposure and WMSDs.

The comments state that the rule “leaves employers guessing as to the level or frequency at which a risk factor becomes excessive and triggers coverage.” The rule, however, has clear and specific definitions for caution zone jobs. It also has clear and specific definitions of hazard levels for employers who choose to rely upon the specific performance option.. There is no guesswork. The general performance

option provides greater flexibility to employers who choose it, not uncertainty for employers who want specific guidance.

The comments state that the rule requires employers to address injuries and illnesses over which they have no control and that employers will have difficulty quantifying hazards if employee's off the job activities contribute to their risk. The comments also state that "employers are left to speculate at what level exposure to work-related risk factors become harmful." These statements are fundamental misreadings of the rule, which contains no requirements for employers to address injuries and illnesses regardless of their cause and which defines hazards very precisely. The rule requires that specifically defined workplace hazards be identified and reduced to the degree feasible. The definition of a hazard is independent of the individual capabilities of any worker because the scientific evidence is that they are hazardous to all workers. Employers have no obligations triggered by the occurrence of injuries, off-the-job activities or pre-existing conditions. An employer who reduces the hazards regulated by the rule will be in compliance.

The comments state that L&I relies "mainly on the experience of only a handful of employers" for its conclusion that a reduction of exposure will result in reduced probability of WMSDs. This is not true. The CES narrative and other material in the rulemaking file demonstrate that there is an ample amount of scientific evidence as well as numerous reports from employers regarding the effectiveness of ergonomics interventions.

##### 5. *The Rule is Not Justified*

The comments state that two L&I reports that the department relied upon are seriously flawed. AWB/WE CARE rely heavily upon an analysis of the L&I reports by Occulink, a copy of which was submitted for the record. L&I has carefully reviewed the Occulink report and disagrees with its analysis and conclusions. Attachment 1 to this summary provides a detailed response to Occulink.

In addition to the Occulink analysis of L&I's report on WMSDs, the comments specifically question L&I's methods of injury coding and contrast them with the coding scheme used by the Bureau of Labor Statistics. The CES narrative has a detailed discussion of the relationship between BLS injury statistics and L&I's reports on WMSD claims. L&I finds that the two reporting systems are fundamentally consistent with one another and AWB/WE CARE's comments to the contrary are based on a misunderstanding of the BLS data.

In addition to the Occulink analysis of L&I's employer survey, the comments specifically assert that L&I exaggerates the degree to which employers have failed to take steps to reduce or prevent WMSDs. The survey, however, found that while WMSD risks were prevalent in all industry types and sizes of workplaces these risks are not being addressed by many businesses. Sixty percent still report no efforts to control WMSD hazards, although 90 percent of firms reported having employees

exposed to some workplace risk factors. Even among employers who said they had WMSDs occur in their workplaces over the last 3 years, almost 40 percent reported they were taking no steps to prevent them. More than 50% of employers who took prevention efforts reported success in reducing injuries. L&I anticipates a much greater degree of success when employer intervention efforts are directed more precisely at reducing the risk factors defined in the rule. These matters are discussed in more detail in the CES narrative and the employer survey report itself, which is in the rulemaking file.

AWB/WE CARE state that the rule is significantly flawed because the choices of exposure levels for caution zone jobs are not based on specific research studies. The CES narrative, however, provides a detailed discussion about the specific studies L&I relies upon for the rulemaking. The reasoning used by the department is described in detail and L&I believes that its analytic method has been fair, objective and thorough. For example, the department describes how it reviewed and analyzed numerous studies and reports that reach negative conclusions.

The comments state that the scientific literature provides inadequate detail about exposure levels in working populations to draw conclusions about exposure-response. The CES narrative reviews the literature in detail and identifies those studies with sufficient information.

L&I's cost-benefit analysis addresses the AWB/WE CARE comments about the economic impact of a rule. The CES, the cost-benefit analysis and other documents in the record provide evidence regarding the effectiveness and affordability of ergonomic interventions. There is substantial evidence in the rulemaking file to support the conclusions of the US GAO and the NAS reports. L&I has thoroughly and systematically evaluated this evidence and explained its reasoning. The rule is not based on anecdotal or testimonial evidence.

#### *6. Rule Conflicts With Other Laws*

The comments state that the rule will require employers to eliminate essential job functions or reduce productivity standards. This is not true. The rule requires that employers reduce exposure to hazards and provides flexibility and choice regarding how this is done.

The comments state that the rule applies to "simple pains and sprains." This is not true. The rule applies to hazards, not injuries or symptoms.

L&I has evaluated the comments that the rule conflicts with the ADA and other laws and has concluded that it does not. This is discussed in the CES narrative and CES Appendix E.

#### *7. Rule Impacts Workers' Compensation Laws*

L&I has considered the comment that the terminology of the rule will impact workers' compensation claims and has concluded that it will not. The rule in no way changes workers' compensation law or rules. The department has stated that it will not change its policies and procedures for the adjudication of workers' compensation claims as a result of this rule. This is discussed in the CES narrative.

The department does not agree that the term "caution-zone" is inflammatory or that it creates a presumption of hazard. The rule states explicitly that caution zone jobs are not necessarily hazardous. This is discussed in the CES narrative.

8. *Rules Raise NLRA Issues Concerning Employee Involvement*

The rule does not give employees "extraordinary powers...in the selection of abatement measures." It does require that employers provide for and encourage employee participation but does not give employees or safety committees any authority or power they do not already have. The rule does not, as the comments suggest, require brainstorming sessions, suggestion boxes, safety conferences or all-employee committees.

L&I has considered the comment that the rule may require employers to violate the NLRA and has concluded that it does not. This is discussed in CES Appendix E.

9. *Costly Experiment on Employers*

L&I has analyzed the AWB/WE CARE economic analysis prepared by M Cubed and finds that it is seriously flawed. L&I's full analysis of this document is in Attachment 2 to this summary. L&I has also completed a full cost-benefit analysis of the rule. The estimated annual cost for compliance is \$80.4 million. The estimated annual social benefit from the rule is \$340.7 million. The benefit-cost ratio is 4.24, indicating that the estimated social benefits substantially outweigh the costs. Interpreted another way, this means that there is a 424 percent return on the investment toward reducing WMSDs. The benefit-cost ratios range from 1.55 for agriculture and forestry to 7.03 for non-durable manufacturing. L&I calculated upper and lower bound estimates on the costs and benefits. Even for the combination of low estimated benefit and high estimated cost the benefit-cost ratio was 3.13. The industry specific benefit-cost ratio for this worst case scenario of low benefits and high costs ranged from 1.15 for agriculture to 5.20 for non-durable manufacturing.

The comments state that L&I has written a "one size fits all" rule. This is not true. Employers are provided substantial choices for identifying and controlling exposure to hazards. This is discussed fully in the CES narrative.

The comments ask that an employer's injury and illness history determine coverage. The CES narrative explains fully that the rule is based on preventing injuries rather than addressing problems after injuries occur.

10. *Current Educational Efforts and Guidelines are Inadequate*

L&I agrees that more technical assistance, education and outreach are necessary but it does not agree that “these efforts have only just begun.” The CES narrative and other materials in the record document more than ten years of voluntary activities including guidelines, free consultation, workshops and other forms of technical assistance and outreach. The CES narrative explains why the department has concluded that these activities have been necessary and useful but not sufficient.

The comments raise a question about how the department expects employers to measure duration. The department agrees that this was not sufficiently clear in the proposed rule and has clarified in the final rule that “duration refers to the total amount of time per day employees are exposed to the risk factor, not how long they spend performing the work activity that includes the risk factor.” The rule does not require special expertise or expensive equipment to make these determinations.

11. *The Rule Ignores OSHA’s Proposal*

The CES narrative and CES Appendix E describe the relationship between this rule and federal ergonomics rulemaking, the department’s reasons for proceeding at this time, and the matter of coordination with OSHA.

12. *The Rule is Subjective and Unworkable*

The comments request more information about the meaning of the terms “feasible,” “safe harbor” and “effectiveness.” This is provided in the CES narrative and other materials in the rulemaking file.

13. *Record of Failure*

The comments state that previous difficulties in applying existing general standards to the control of WMSD hazards will continue with the new rule. However, the department believes that the rule avoids previous difficulties by providing clear and specific criteria that tell employers when they are covered, what hazards must be controlled, and the levels below which exposure must be reduced. The specific elements of the rule will assist the department in providing fair, consistent and predictable enforcement. At the same time the rule provides employers with substantial choices and flexibility in how they identify and reduce hazards. A more complete discussion is in the CES narrative and other materials in the record.

14. *Conclusion*

L&I has examined every general and specific comment made by AWB/WE CARE. The department’s full analysis may be found in the CES narrative and CES attachments as well as this summary and its two attachments. The department believes it has responded thoroughly and thoughtfully to the comments. In a few



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cases the department agreed with the comments and has made changes to the final rule. In most cases the department disagreed and has explained why.

### **Attachment 1: Response to the Occulink Report to WE CARE**

1998 Employer Survey (SHARP 1999)

1990-1997 WMSDs in Workers Compensation (SHARP 1999)

#### **Employer survey**

1. *Use of “gradual onset” may be misinterpreted as referring to degenerative joint disease of the knee or spine.*

This is highly unlikely since it is doubtful that most employers know about the arthritides of their employees. Nonetheless, osteoarthritis of the knee has been strongly associated with occupations in which there is exposure to kneeling, squatting, stair climbing and jumping at work, while controlling for BMI, age, gender. The term “cumulative trauma disorders” has been in the popular press since the 1980s to refer to disorders of peripheral nerves, tendons, muscles, joints and supporting structures related to physical loads at work. In the survey, the term “gradual” was used to differentiate from acute traumatic origin. There was no reason to provide an independent review of the casual association between work-related risk factors and MSDs in the survey report since an exhaustive review of the epidemiological literature was available from NIOSH. The NIOSH review received thorough peer review and its methodology found sound (NRC, 1999). Additionally, there have been a number of animal and human laboratory studies that have identified “microtrauma” as an aetiological factor in nerve, tendon fiber damage and vertebral endplate microfracture (e.g. Brinckmann, Johannleueling, et. al. 1986, Goldstein, Armstrong, et al. 1987, Viikari-Juntura and Silverstein 1999, and Armstrong, Buckle, et al. 1993)

2. *Use of a small portion of eligible employers in the survey*

The use of stratified random sampling (stratified by employer size and industry) is an appropriate methodology in survey research. A response by almost 5,000 firms is not a small survey.

3. *Self reports*

Employer reports of exposure are less reliable than direct observation by researchers. There have been a number of studies comparing employee reports of exposure to observational methods with some reporting moderate to good correlation and usefulness in epidemiologic studies (e.g., Punnett 1998, and Pope, Silman, et al. 1998). Given limited resources and wanting the same information from different sized employers and different industries, self-reporting by employers was considered a reasonable alternative. Similar employer survey results have been reported by others (Houtman, Goudswaard, et al. 1998).

4. *Questionnaire administration*

The survey was sent to the person in the firm responsible for health and safety. The assumption was made that this person would be most knowledgeable about risk factors and MSDs.

5. *Reporting injuries*

Occulink expressed concern about consistency in reporting MSD injuries. Yet it is quite reassuring that the injury rates based on the employer-reported rates were quite similar to those identified in the workers compensation system.

6. *Reporting employee exposures*

It is most likely that employers estimated exposures and their duration based on their everyday knowledge of the job. It is unlikely that they performed job analyses. Thus, there may be some misclassification in either direction (over or underestimate of exposure). This is inherent in survey research. The issue is differential misclassification, which seems unlikely. For example, if we had given more detailed instructions to some employer groups but not others, systematic bias might have been introduced. It is more likely that small employers (n<11) would know all their jobs better than large employers (n=50+). Stratification by employer size and industry in the analysis addresses this issue to the extent possible.

7. *Poisson models of risk in the employer survey show both positive and negative risk predictors. It appears that some previously reported risk factors are protective.*

The decision to keep the 1998 employer survey as simple as possible resulted in a high response rate of 75%. The goals of a survey are very different from an epidemiological study. Its purpose was to describe the extent of exposures. One of the limitations of the survey design was not being able to look at combined exposures, such as number of employees exposed to both high force and high repetition, or awkward postures and intensive keying. Additionally, we were not able to separate WMSDs by body region. Thus, for statistical modeling purposes, we could only look at all WMSDs and each risk factor. One would not expect to find a positive association between, for example, intensive keying and back or lower extremity WMSDs, and in fact these results point this out. Most of the exposure-response relationships were identified with manual handling, working with the hands above the shoulder, repetitive arm work, and use of vibrating tools. An additional limitation of the Poisson regression analyses was the tradeoff between the number exposed to a particular risk factor and the duration of the exposure. In the industry sector specific analyses for example, scarcity of data points, particularly in some high exposures, made analyses difficult.

8. *No definition of ergonomics program*

It is highly unlikely that an employer who had an ergonomics program did not know what one was. The adequacy of the program was not specifically addressed.

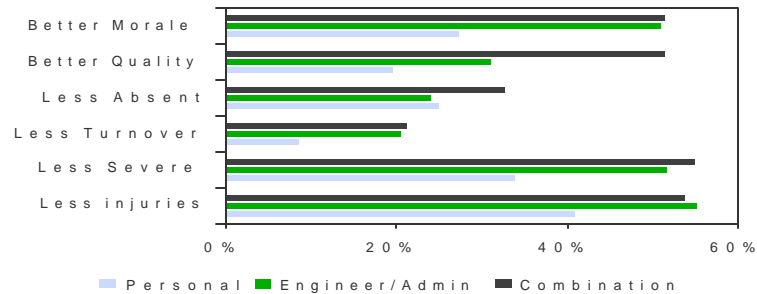
9. *Helpful to know who responded*

We agree that it would have been helpful to include the occupations of the respondents in the report.

10. *Based on the employer survey, it appears that employers don't see a significant problem related to MSDs and a programmatic response by those reporting injuries.*

It is encouraging that 61% of those who recognized that they had musculoskeletal injuries were taking some kind of steps to prevent them. However, it is also apparent

Figure 2. Percent with Benefits by Type of Controls for those Reporting MSDs



**SHARP**

that they are not necessarily taking the most effective steps. Of those firms reporting WMSDs and who took prevention steps, a larger percent had improvements with only engineering or administrative controls compared to those who only used personal controls (PPE, exercise).

Almost 40% of those who did recognize they had MSD issues in their workplace indicated they were taking no steps. This does not take into account those employers who are unaware of MSDs or work-related hazards in their workplaces.

The employer survey reports employer perception of presence of risk factors in the workplace and MSDs, we did not validate the exposures via independent observations. However, the reported incidence of claims in the survey was quite similar to the overall incidence rate reported in the workers' compensation data, thereby increasing our confidence that employers were reporting as well as they could. Additionally, the high response rate for this survey suggests representativeness of responses.

## WMSD Report Issues

### 1. *Coding of claims as gradual and sudden compared to BLS “repetitive motion” classification*

The coding schemes between the two systems are different. Second, “repetitive motion” does not take into account postures and forces due to lifting, push/pull/carry/reaching, bending, twisting or use of vibrating tools and equipment. These exposures can be either repetitive or static and contribute to WMSDs. The ANSI z16.2 codes are limited in that the only time “repetitive motion” can be coded is related to rubbed

or abraded. This explains why it is not a particularly useful code compared to the OIICS codes of BLS. A review of a number of claims individually increases our confidence that most of the “repetitive motion” claims under the BLS definitions would be coded primarily as one of the overexertion codes in the workers' compensation data. The proposed ergonomics rule is not limited to reducing just repetitive motion disorders.

2. *Comparison of codes versus review of medical records*

In the report discussion, it was noted that misclassification of codes was because the type codes were 995-999 (unspecified). It appeared that coders recognized that there were no good separate codes for repetitive motion or awkward postures in the z16.2 codes. With both state fund and self-insured data, “sudden” codes included struck by, struck against, falls, caught in, under, between; motor vehicle accident, and for back-bodily reaction as well as unspecified. It is the unspecified code that turned out to be predominantly those risk factors associated with manual materials handling (push/pull/lift/carry/throw).

The survey and claims database analyses do not provide an independent assessment of physical work functions as they relate to potential risks and effects of intervention measures. The analyses do not provide objective, validated findings on the effects of specific workplace interventions....further research is needed.

The claims database analysis was conducted to assess the magnitude and distribution of WMSD claims by industrial classifications and that is what it did. An earlier comparable analysis of claims using the same methodology was reported in the peer-reviewed literature. The employer survey was intended to survey employers' perceptions about the prevalence of MSDs and reported risk factors in the workplace, what employers are doing about the problem, and where they go for help. This is the largest survey of its type and it provides the best available information about those employer perceptions. Occulink does not describe what is wrong with the survey methodology. The employer survey results are in the peer-reviewed proceedings of the International Ergonomics Association Triennial Congress, 2000. The methodologies used in both of these reports are robust and report what they were intended to assess. Occulink appears to be confused about the purpose of the studies, the methods and the results. Clearly, field investigations are needed to assess the effectiveness of interventions in workplaces where they take place. There are numerous examples in the literature comparing those exposed to those lesser-exposed and comparing rates before and after workplace improvements.

The survey and the WMSD report provide useful information on the magnitude and distribution of exposure to reported risk factors for WMSDs and the burden of WMSDs in Washington State. These reports add to the growing body of evidence that WMSDs present a large social burden and can be prevented in large part by primary prevention activities in the workplace.

## **Attachment 2: Response to the M. Cubed Report to AWB**

### **General Points:**

1. The M. Cubed report provides no evidence, data, or published materials for identifying the population they claim to be exposed to either caution zone jobs or hazardous jobs. They erroneously assume 60% of employers having at least one caution zone job means 60% of jobs will be in a caution zone. This is simply untrue. Based on what approximately 5,000 firms reported (1998 Survey of Washington Employers on WMSDs, SHARP Technical Report 53-1-1999), roughly 18% of employees would be in caution zone jobs and therefore covered.
2. The M. Cubed report assumes that an outside ergonomics consultant will have to be hired at \$75/hour by every employer to figure out if they are covered by the rule. This is not true. The rule was written so average employers could make a quick determination of whether they have covered jobs. L&I will not second-guess good faith, reasonable determinations.
3. The M. Cubed report provides no data or description of assumptions or methods they used to estimate hazard controls costs. Once again, they appear to use the fraction of firms requiring controls rather than the fraction of jobs requiring controls. They estimate that every workplace with more than 50 employees will have to spend \$1,000,000 every year to fix hazardous jobs. The only basis for this estimate is that employers in California in 1994 guessed that this is what the California ergonomics standard would make them do. This hearsay information bears no relationship to the requirements of the Washington ergonomics rule, and grossly exaggerates what employers in Washington will need to do.
4. The M. Cubed report made no cost adjustments for the 6-year phase-in period of the WASHINGTON ergonomics rule, and there is no apparent discounting of future costs. These adjustments are standard practice for cost-benefit analyses.
5. The best evidence that the M.Cubed report estimates are way off base is that many employers in the state who have undertaken ergonomics voluntarily have repeatedly testified that they have been able to reduce hazards for reasonably low costs and high benefits. And most of these employers are going way beyond what the rule would require them to do. For example, many employers are purchasing "ergonomic chairs" and "ergonomic keyboards". The rule does not require this.

### **Specific Points:**

1. *Section 3.1: WMSD cases lower than asserted by L&I*  
The authors refer to BLS repetitive motion classification. WMSDs are caused by more than repetitive motions. These include static loading, high forces including manual materials handling activities, awkward postures, and vibration. Combined,

neck, upper extremity and back WMSDs represent at least 26% of all accepted claims. The WASHINGTON ergonomics rule addresses all of these risk factors. Additionally, while WMSD rates have been declining, the rate of decline is significantly less than for non-WMSD rates. For upper extremity WMSDs, particularly shoulder and elbow, there has not been a significant downward trend. Non-traumatic epicondylitis is increasing (SHARP, 2000). Additionally, the median age of claimants has not increased significantly over the last 9 years. The SHARP reports have shown the number of individuals and number of claims for WMSDs. While one person may have more than one claim, it would be in another body region or the same body region but in a different limb and reported at a different time. It is more likely that the differences in BLS reports besides separating overexertion from repetitive motion is that BLS rates are for those with lost time whereas the SHARP reports for the State Fund include medical only and those resulting in less than 4 lost workdays. The authors' footnote 15 referred to in Table 2 is wrong. Non lost workday cases do show up in the workers compensation data.

2. *Section 3.1: Most WMSDs are not related to occupation but to aging, obesity and deconditioning*

Most occupational epidemiologic studies control for age and obesity in their analyses. It is unlikely that older and more obese workers would self-select or be selected differentially into jobs with high physical demands. Table 3 refers to vision-related injuries but does not define them. Vision-related injuries are not considered in the ergonomics rule. There is little doubt that WMSDs are multi-factorial in origin including work factors as well as individual factors. Under the ergonomics rule, the employer is responsible for addressing the work-related physical load factors, not the individual or work-related psychological and social factors.

3. *Section 3.2: Upper body injuries*

The authors reference Hadler's reference to the NHIS data reported by Tanaka et al with self-reported and self-reported medically diagnosed CTS, etc. in terms of population distribution but neglect to point out Tanaka's identification of repetitive wrist bending and vibration as increasing the risk, nor Blanc's analysis of the same data which demonstrates a dose-response relationship between disability from CTS and hours of exposure to repetitive wrist bending (see Concise Explanatory Statement tables). Nathan's studies suffer from poor methodological considerations as described in the Concise Explanatory Statement. Virtually none dispute the multifactorial nature of neck and arm pain in the workplace.

4. *Section 3.3: Back injuries*

These disorders also have a multi-factorial etiology. A review of the positive and negative epidemiological studies among working populations by Burdorf & Sorock (see the Concise Explanatory Statement) conclude that manual material handling activities and whole body vibration are indeed risk factors for LBDs.

5. *Section 3.4: Ergonomics strategies*

The authors recognize that in some cases ergonomics has been effective in reducing WC claims incidence or severity and cite the SHARP 1998 Employer Survey report. There was a difference in perceived benefits based on type of solutions employers used (Silverstein & Foley, 2000). Those using engineering and administrative controls had more positive results than those who used personal controls. One of the limitations of the survey was that it did not inquire how long the controls had been in place. The authors think there may be a difference in success rates based on voluntary versus mandatory efforts. The examples of Perdue, IBP, Chrysler etc that received large OSHA citations suggest that mandatory interventions are also successful. The authors point out that most employers phase in their ergonomic improvements. That is consistent with the long phase-in period of the WA ergonomics rule. The authors believe that standard methodologies across workplaces are hard to find and cite Garg & Owen on nursing homes. However Garg 1999 has just completed a report on implementing no-lift programs in a large nursing home chain with substantial results. Ergonomic principles have universal application even though individual workplaces may have different jobs.

6. *Section 3.4.1: Insurance market doesn't place an explicit value on ergonomic interventions*

Why then does Liberty Mutual and Travelers have such extensive ergonomics activities to assist policyholders?

When safety behavior is unobservable by the insurer it is often true that insurance premiums are not reduced. Examples:

- 1) for years insurers did not give discounts on car insurance to drivers who wore their seatbelts, and in fact were instrumental in the push toward *passive* restraints for the very reason that observability would thereby be eliminated as an issue;
- 2) life insurance companies don't offer discounts to persons for such unobservable behaviors as eating a healthy diet or exercising, even though these "interventions" are proven to reduce disease and mortality.

7. *Section 3.4.2: No proven health claims available for ergonomic devices*

The authors appear to misinterpret ergonomics. Just because a keyboard manufacturer claims that an alternative design keyboard is "ergonomic" does not mean this is so. The workstation/equipment-worker interface needs to fit in order to have an ergonomically designed work environment. Table 5 is an example of this misunderstanding of ergonomic principles.

8. *Section 4.0: Estimated costs to Washington taxpayers and businesses*



“The total costs of these interventions would be determined by the per-firm or per-employee cost of the intervention, and the number of firms required to make it”

The only rational way to estimate control costs is to estimate the number of jobs which require fixing and the costs per job of the control. This is because the number of jobs which require fixing will vary from one employer to another. The authors are not clear how they estimate the fraction of firms which will need to fix jobs (see section 4.0.4) but more importantly they do not explain how they estimate the number of jobs which will need to be fixed. Since there is no presentation of their methods, it is impossible to assess their approach except to say that it appears illogical.

9. *Section 4.0(2): Identification of caution zone jobs*

The Washington ergonomics proposal made a generous assumption of the time required to perform the initial identification of caution zone jobs. The M.Cubed analysis confuses this step with the more in-depth analysis required for jobs in the “hazard zone”. In addition, the Washington ergonomics proposal made the generous assumption that each worker employed by the firm works in a separate job. Thus if 20 workers are exposed to one or more of the hazards for 2 or more hours, then 20 jobs will be caution zone jobs. This is likely to be an overestimate of the number of caution zone jobs, especially at large firms where shift work means several workers per each distinct job.

The authors note “it would seem appropriate for firms to engage outside expertise”. The Washington ergonomics proposal was not based on an analysis of what some firms may choose to do under this rule, only what they will be required to do. In this case the rule does not require that the initial caution zone identification step be done by an outside consultant. The step is a simple one designed to be done easily and quickly by in-house staff.

10. *Section 4.0(3): Conduct “hazard analysis” of “caution zone jobs”*

The author's assumption of four hours for small firms or sixteen hours for large firms must be a total, not per-job, time estimate. As such it is in line with the Washington ergonomics proposal assumptions of one hour per job for small firms and three hours per job for large firms.

*The author's state* “based on available evidence it was assumed that 60 percent of all employers would need to conduct the hazard analysis...these costs would re-occur every three years”.

No data sources or methodology is given to buttress this claim of 60 percent of employers would need to conduct hazard analyses. In addition, it is not the number of employers needing to do hazard analyses that must be estimated, but the number of jobs needing analysis. This is the approach Washington took in the SBEIS. Costs per job analyzed were first estimated based on the results of a 1999 survey of Washington

employers. This was multiplied by the estimated number of jobs requiring analysis, obtained from an earlier Washington employer survey (1998). Costs per firm were then obtained by dividing the total cost of analysis in a given industry by the number of firms in that industry. It makes no sense to use the percentage of employers with hazard jobs to estimate total costs since most employers will only have to analyze a few of their jobs, not all of them (or even 60% of them, if that is what the authors mean). In their footnote 69 they cite the Washington Employer Survey indicating 78% of large, 57% of medium and 23% % of small businesses reporting MSDs in the previous three years as evidence that the fraction of jobs in the caution zone was underestimated. First, having an MSD does not mean having a lot of caution zone jobs; second, having an MSD is not proof that the job the worker was doing was a caution zone job.

11. *Section 4.0(4): Adopting engineering, administrative, or individual controls*

The authors note: “Available estimates indicate per-firm ergonomic costs ranging from \$250 to \$1,000,000 depending on the affected economic sector and firm size. The estimates contained herein are based on a federally-sponsored survey, as well as a review of available data on the likely costs associated with particular industries”.

There is no citation or source given for this evidence. For the Washington ergonomics proposal, the method for using control costs is fully explained in the SBEIS and the document we used to obtain these estimates is in the rule file.

The authors note: “The population affected by this rule was assumed to be greater than DLI’s assumption, to better account for firms which would have to modify already implemented ergonomic approaches”.

Once again there is no discussion of how they arrived at their unstated assumption of the fraction of the population affected. They seem to be basing their discussion on a fraction of firms rather than of jobs, which is an unsound approach.

In footnote 71 they show a basic misunderstanding of the Washington analysis when they say, “DLI asserts that per firm costs for ergonomic interventions could average as low as \$30. This expenditure, however, wouldn’t cover much more than a wrist splint or back pillow..” This is because the Washington SBEIS divided the total costs of fixing ALL hazard zone jobs in an industry by the number of firms in that industry, not just by the number of firms expected to have to fix jobs. Many firms will have few or no hazard zone jobs while some other firms will have to fix many jobs. Our approach simply represents the average experience in each industry.

Their Table Six, which summarizes the per-firm annual costs of ergonomic controls is unaccompanied by any presentation of methods. For example, are these costs averaged over all firms in an industry or only those firms actually having to fix jobs? How many jobs in each industry have to be fixed, according to these figures? Are these costs discounted? At what rate? Over how many years are these costs

annualized? No discussion of any of these issues appears anywhere in the text. Without this information, these numbers are impossible to interpret.

An example of how unrealistic their figures are: A cost of one million per year for large manufacturing firms for ergonomic controls. What could they be buying every year that would cost this much? If the firm had 100 employees (a little higher than the average size firm in this size category) they would be spending \$10,000 per employee every year!

12. *Section 4.0(7): Increases in workers' compensation costs due to "signaling effect"*

The authors argue workers' compensation (WC) costs will rise as more workers make WMSD claims under the rule. This is curious since they argue this is due to a fall in "disincentives" including fear of reprisals from employers, loss of income, change in job status, peer pressure, etc. That is, they admit that not all eligible WMSDs enter into the WC system where they belong. But elsewhere (Section 3.1) they limit the number of MSD cases to "no more than the 50,000 MSD cases" that result in WC claims. This is a contradiction. If MSDs are legitimately related to work, they belong in the WC system. The workers are paying for this insurance through wage deductions and they deserve to obtain relief. As a side issue, we want these legitimate cases to appear as claims so that our public health surveillance will be as accurate as possible. Claims acceptance procedures will not be affected by the rule. If the burden is shifted from the worker or from the worker's employer-sponsored health insurance system to the workers' comp system, then this is not an additional burden. True, if the workers are uninsured, then costs will shift from workers to employers (partially), but otherwise employer health care costs should fall as their WC costs rise.

13. *Section 4.1: Estimated direct costs*

The authors note: "These estimates are an order of magnitude higher than the ones developed by DLI. This is chiefly because DLI's estimate of the affected employer population was adjusted upwards". This is the key difference, but since they have not documented their method of estimating the fraction of the population affected by the rule, and because their employer-based approach is flawed, their cost estimates are not correct.

14. *Section 5.1: Changes in employer health insurance and workers' compensation*

The author's discussion is confusing. First they claim, without data, that there will be no decline in WC expenditures for six years after "implementation," after which they assert, again without evidence, that "after 2006 MSD-related costs may decline by an unknown but potentially significant amount." So far this sounds very like our own planned approach, where we do not expect significant impact on WMSDs until controls are required to be in place, which varies depending upon the industry and size of each firm. But then the authors go on to state that any savings from reduced legal expenditures (again no evidence cited, the authors use "might," "would" and

“could” repeatedly) would not “offset total MSD case increases”. Throughout this section they jump back and forth between “costs” and “incidences” (their term), in contradictory ways.

The authors then go on to assert, in contradiction to their presentation in Section 3.4 (1), that some firms “will be able to reduce WC outlays through successful incorporation of ergonomic programs into general health and safety initiatives to improve their workers’ compensation risk rating”. Why should rates go down unless ergonomic interventions can be effective? The authors claim such successes will be limited to large, self-insured firms only because “most small firms are not eligible for [risk] rating or outcome reviews”. Leaving aside the existence of the retrospective rating program, or even new initiatives the Department may undertake to help create financial incentives through the WC rate system, the authors are wrong here. If, due to regulation, an entire risk pool of firms adopts ergonomic practices and achieves any reduction in average loss experience, WC rates will go down. This would certainly be true in Washington’s State Fund, where mounting surpluses in recent years have led to several rate reductions, perhaps even more readily than would be the case in a private insurance state.

15. *Section 5.2: Productivity changes*

This section is all speculation - no data, no analysis, no review of the literature is provided. The authors begin by asserting: “labor productivity could either increase or decrease as a result of the regulation”. They follow this with a listing of the factors which could increase productivity: better morale, “healthier workplace,” decreases in absenteeism, reductions in turnover, training and increased use of “job screening” to allocate workers to tasks for which they are physically best suited. Factors leading to a decline in productivity: longer breaks, more breaks, job rotation and attendant re-training disruption of workplace to implement ergo improvements.

The authors then speculate, without data, that employment may decline as higher labor productivity leads to layoffs. This is a very complicated problem in economics, requiring general equilibrium methods usually involving large computer simulations, and even then the predictive success has been very poor. To simply assert that employment “would” decline is astounding. Needless to say, labor productivity is influenced by a vast set of factors, always changing, so it is rather simplistic to claim a measurable impact will arise from a small change in just one of these factors. But this is what they have done. Historically, of course, it has not been true that labor productivity increases (average 1-2% a year in real terms) have led to employment declines. Rather the reverse has been true, probably because productivity gains cause higher living standards, increasing the demand for goods and services, and thus increasing employment in those sectors.

They follow this with a paragraph from OSHA’s 1999 cost-benefit analysis that is supposed to support their assertion. But it deals with how the benefits of the standard will be split between employees and employers.

Their claim that wages would have to fall upon implementation of ergonomic interventions “if the rule is ever to benefit employers” prompts two responses: first, any such wage reductions would have to come from the “risk premium” allegedly built into wages to compensate workers for hazardous work. But the existence of these risk premiums is controversial (see Dorman, 1996), especially in the case of such complicated, cumulative risks as WMSDs; secondly, if the wage reduction did occur it would be a benefit only from the perspective of employers. In the WASHINGTONSBEIS and the cost-benefit analysis we have to take the perspective of benefits and costs to society as a whole, not just business alone or workers alone.

*16. Section 6.0: Impact on the Washington economy*

The author's analysis here depends largely upon the veracity of their earlier claim that the rule will result in \$725 million in annual costs, which is very far off the mark. In any case, the impacts they purport to show in this section are very doubtful.

- Their table on Washington job growth is a one-year only figure. 1999 was a poor year for a few large manufacturing firms in the state. Their figure of 1.9% is not far below the national average of 2.1%.
- The impact on Washington's ability to compete with out-of-state firms would be limited to those sectors where the products can be consumed at a site separate from where they were produced. Construction, retail and most services would not be affected. Also, the impact for the other sectors would depend on the average cost relative to average profit. This will likely be so small as to not affect either wages or prices in any significant way.
- As for the automation argument: once again the impact in the vast majority of cases is so small as to be insignificant relative to other forces influencing automation; second, in certain cases where the influence is greater, feasibility will be the guide.

*17. Section 6.1: Estimated employment loss*

The authors claim 2,150 job-years would be lost annually throughout the period. This is derived from feeding their cost estimate into an input-output model maintained apparently by the U.S. Forest Service for the Washington economy. No presentation of this model is offered, no evidence is given of how well it has performed in previous applications. However, such models are well-known to contain errors and uncertainties (due to the complexity of the interrelationships which they model) resulting in “statistical confidence limits,” within which it is impossible to be more precise. To argue that a model has predicted that the Washington economy will lose fewer than 1 job in 1000 due to this rule (inflated as that impact may be) means that an impact of zero job loss must be well within any such a prediction's confidence limits. Such an estimate is statistically meaningless.

### **Response to Comments by United Parcel Service (UPS): Summary**

The department has analyzed and responded fully to the comments by UPS and the attachments to these comments. The department response may be found in three places: this summary and its attachments, the CES narrative and Appendix D to the CES. This summary follows the table of comments in the UPS submission and indicates where the department responses may be found.

This summary is accompanied by several attachments:

Attachment 1: Response to Selected Comments Regarding the Science

Attachment 2: Strong Studies on Causal Association

Attachment 3: Review of Studies by Nathan

Attachment 4: Review of Studies about Psychosocial Factors

Attachment 5: Review of Studies by Bigos

Attachment 6: Response to Comments about Weight Limits in Appendix B

*1.A Ergonomists are unable to determine when work caused a supposed CTD, and leading physicians dispute that CTDs even occur.*

The department does not use the term “CTD” in this rulemaking and it is not relevant whether physicians argue about it. At no point in its comments does UPS address the more pertinent issue of how L&I defines and uses the term “work related musculoskeletal disorders (WMSDs).” UPS does mention the related term “musculoskeletal disorder” and, in a footnote, states that L&I uses this term to describe “ubiquitous pain, discomfort, and fatigue.” This is a misleading assertion that has no foundation whatsoever in the rulemaking file.

The rule is based on a wide body of scientific evidence about the relationship between WMSDs and exposure to physical risks at work including awkward postures; high hand force; highly repetitive motions; repeated impact; heavy, frequent, or awkward lifting; and moderate to high hand-arm vibration. Because the rule focuses on particular hazards and their reduction or elimination, it is not necessary to reach a definitive conclusion about a specific instance of injury or disease. There is compelling evidence that groups of workers exposed to the regulated hazards experience high rates of WMSDs. It is sufficient to conclude, based on the evidence, that the elimination or reduction of certain specific hazards at work will in turn result in a substantial reduction of WMSDs.

The department agrees with UPS that usage is a prerequisite to health and not a “generic evil.” However, L&I also believes that too much usage is harmful. The rule addresses only these harmful exposures. The department also agrees that fatigue is not necessarily harmful. The rule does not regulate fatigue.

The department’s full discussion of the scientific issues is in the CES narrative and supported by the rulemaking file. Attachment 1 to this document also discusses this issue,

and Attachment 2 provides information on studies related to the causal association between specific risk factors and MSDs.

*1.A.1 Carpal tunnel syndrome is not presumptively work-related.*

UPS misstates that the department “seeks to regulate...carpal tunnel syndrome.” The rule is hazard based, not injury triggered. The rule regulates exposure to workplace hazards, some of which are known to cause increased risk for carpal tunnel syndrome.

The department does not presume that all carpal tunnel syndrome is the result of work related exposures. It is sufficient to conclude, based on a wide body of scientific evidence, that a substantial number of cases of CTS are caused or aggravated by work and that the elimination or reduction of certain specific hazards at work will in turn result in a substantial reduction in these work-related instances of carpal tunnel syndrome.

The basis for the department’s determination is discussed more extensively in the CES narrative and is supported by the rulemaking file. The Nathan articles (UPS Attachments 3 and 4) are specifically addressed by Attachment 3 to this summary. The flaws of the Schottland study are addressed in the CES and by several other documents in the rulemaking file.

*1.A.2 Back pain is not presumptively work-related.*

The department does not presume that all back pain is the result of work related exposures. It is sufficient to conclude, based on a wide body of scientific evidence, that a substantial number of back injuries are caused or aggravated by work and that the elimination or reduction of certain specific hazards at work will in turn result in a substantial reduction in these work-related back injuries.

The basis for the department’s determination is discussed more extensively in the CES narrative and is supported by the rulemaking file. It is also discussed in Attachments 1 and 2 to this document.

*1.B. Musculoskeletal complaints are heavily influenced by factors unassociated with job tasks.  
(including 1.B.1 and 1.B.2)*

L&I does not disagree that “occasional musculoskeletal pain and discomfort are part of everyday life.” However, the rule regulates only those workplace hazards that are known to cause WMSDs.

L&I also does not disagree that musculoskeletal disorders have many causes, that a single case can be multifactorial, and that “finding one’s way through this maze” is difficult. L&I believes that the scientific methods of epidemiology are particularly well suited to the study of such complex cause and effect relationships. In its review of the scientific evidence, described in the CES narrative, the department placed special emphasis on

those studies that were carefully designed and analyzed to control and account for the effects of such confounding variables as age, obesity, psychosocial stress, systemic illness, gender, and non-work physical stresses. The department's conclusions about work-related causes thus takes into account the non-work influences discussed by UPS.

UPS mischaracterizes the Pepperidge Farm decision and the comments of Dr. Barbara Silverstein in that case. It is not relevant to this rulemaking that some cases of carpal tunnel syndrome or other upper extremity musculoskeletal disorders have non-work causes. The most important conclusion of the Review Commission in Pepperidge Farm is included in the department's response to I.E. below.

The psychosocial factors discussed by UPS are addressed in the CES narrative and the attachments to this summary. The department has explained why non-work psychosocial factors do not invalidate this rulemaking. The department has also explained why it decided not to regulate work-related psychosocial risks.

The comments suggest that beliefs about the work-relatedness of MSDs may be "'iatrogenic', that is, brought about by ergonomists, some doctors, and concurrent 'sociopolitical' publicity." As an example, the comments state that iatrogenicity is the explanation for "the CTD panic that swept Australia in the 1980's." The department disagrees and believes there is evidence that exposure to hazards at work have caused WMSDs in Australia in much the same way they have in this country. The department also believes there is evidence that Manual Handling legislation and regulations in Victoria and elsewhere in Australia have had a positive role in reducing WMSDs (David Caple testimony for OSHA ergonomics hearings 3/2/00).

It is not necessary for the department to conclude that no other factors result in MSDs. It is sufficient to conclude, based on a wide body of evidence, that many MSDs are caused or aggravated by work and that the elimination or reduction of certain specific hazards at work will in turn result in a substantial reduction in these WMSDs.

The basis for the department's determination is discussed more extensively in the CES narrative and is supported by the rulemaking file. It is also discussed in Attachment 1 to this document. Discussions of the studies by Bigos, by Linton and Kamwendo, and by Krause et al are provided in Attachments 4 and 5.

*I.C. Even ergonomists concede that no consensus exists as to when particular job tasks become hazardous.*

The CES narrative explains why consensus among scientists is not a necessary prerequisite for this rulemaking. The best available evidence about exposure-response relationships is very strong and is easily sufficient to support the department's regulatory action. This is discussed in the CES narrative, attachments to this summary and other documents in the rulemaking file.



UPS devotes 10 of 56 pages in its submission to a criticism of the 1991 NIOSH lifting equation, a tool not required by the rule. While the rule does not require employers to use the NIOSH lifting equation, L&I has concluded that it is a valid and useful tool and would be appropriate and acceptable for employer use. L&I's reasoning and decisions are discussed in the CES narrative, Attachment 6 to this summary and other documents in the rulemaking file including comments by Keyserling, Norman, Garg and Lavender.

As elsewhere in this submission, the comment incorrectly identifies Dr. Barbara Silverstein as "the author of this rule." Dr. Barbara Silverstein is the Research Director of the Department of Labor and Industries and is responsible for much of the scientific analysis on which the rule is based. However, she is not the author of the rule. No one person can be identified as the author of the rule, but the rule was developed by the WISHA Services Division of the Department of Labor and Industries under the authority and direction of Dr. Michael Silverstein, Assistant Director for WISHA Services. The rule was proposed and the final rule will be adopted by Gary Moore, Director of Labor and Industries. Although Dr. Barbara Silverstein and her staff were appropriately consulted in relation to scientific conclusions and other research responsibilities, it is inaccurate and misleading to characterize her (or her staff) as having authored the rule.

*I.D. Effective ergonomics solutions are elusive.*

Evidence of effective ergonomics solutions is extensive and widespread. The rule does, however, recognize that "one-size-fits-all" solutions are inappropriate and provides employers the flexibility to choose the methods most suitable for the specific circumstances to reduce exposure to hazards. UPS fails to provide any specific evidence that reducing exposures below the hazard levels defined in the rule is known to be ineffective. The effectiveness of ergonomics is discussed in the CES narrative, and is supported by the rulemaking file.

*I.E. Ergonomics consistently fails the Supreme Court's "junk science" test*

The UPS assertions essentially repeat those made earlier by Hadler in the Journal of Occupational and Environmental Medicine (Hadler 1996). L&I considered these arguments at the time and concluded they were fundamentally flawed. L&I's analysis and conclusions were published as a companion piece to the Hadler editorial (Silverstein M 1996) and remain the agency's view at this time. No court has held that properly conducted and applied epidemiology or other biomedical sciences relied upon in this rulemaking are "junk science." The fact that individual witnesses may have been discredited in specific cases is irrelevant to this rulemaking. It is more relevant, however, that the OSHA Review Commission concluded in Pepperidge Farm (characterized by UPS as the "leading case"): "While there was no unanimity of opinion in the record, we find Dr. [B] Silverstein's testimony to be the most persuasive...The evidence presented by Dr. [B] Silverstein supports the existence of a causal connection between the work performed and upper extremity musculoskeletal disorders."

The validity of the scientific evidence on which the specific hazards addressed by the final rule is based, as well as its sufficiency as a basis for rulemaking, is discussed more extensively in the CES narrative and is supported by the rulemaking file.

*II.A The “criteria” at the heart of the proposed rule are not “widely accepted” and “nationally recognized”; rather they are unreliable and conflict with one another.*

The evidence regarding exposure-response relationships and L&I’s specific conclusions about hazardous levels of exposure is discussed in detail in the CES narrative and other documents in the rulemaking file.

UPS’ specific comment refers to the alternatives allowed under the general performance option in the rule. L&I agrees with UPS that it would be inaccurate to describe the listed methods as “nationally recognized.” Therefore, this term has been eliminated in the final rule and replaced by the more accurate “widely used.” L&I also agrees that the Liberty Mutual tables provide insufficient recommendations about hazardous exposure levels and therefore these tables have been removed from the final rule. L&I also clarified that employers using alternate methods to Appendix B “must use hazard control levels as effective as the recommended levels in widely used methods.” L&I believes that using any of the listed examples in this manner will result in effective control of hazards as defined in the rule. The basis for this is supported by the rulemaking file and is discussed in further detail in Attachment 1 to this document and in the CES narrative.

A discussion of some of the specific concerns raised in relation to the NIOSH Lifting Equation is found in Attachment 6 to this document. The final rule also clarifies that its reference to the 1991 Lifting Equation is “as described in Waters 1993”. While Waters notes that the evidence is not perfect, he concludes that “the chosen lifting criteria can reliably predict the risk of lifting related low back pain. Subsequently two studies have successfully demonstrated a relationship between the NIOSH Lifting Equation and low back disorders (Water, Baron et al. 1999; Wang 1998).

*II.B. The rules alternative “specific” standard also is unsupportable and fails to make clear the scope of the analysis or of the remedial measures an employer must undertake.*

The rule balances specific guidance with appropriate flexibility for employers in making credible assessments of hazards (using the criteria in Appendix B if they choose the specific performance option) and in identifying solutions that will eliminate those hazards. When risk factors have been reduced below those hazardous levels, the employer is in compliance.

The comments suggest lack of clarity in the rule but no uncertainty exists if the rule itself is referenced. For example, the comments suggest that an employer using the specific performance option would not know what to do “if a particular task appears to have a CTD hazard for short employees but not for those who are taller, or only for those employees with small hands, or who work in cold areas, or who are overweight, or female, or of advancing age?” Appendix B provides specific guidance in assessing

whether or not a hazardous exposure exists. None of the risk factors identified in Appendix B are determined by the employee's weight, gender, age, or hand size. For controlling reaches over the shoulder or head, height may be a factor and the employer must control the hazard to the extent it exists by providing appropriate controls that allow each employee to work safely.

The comments raise several questions about job analysis such as whether the rule requires "time consuming and costly time-and-motion studies." The CES narrative explains that representative sampling may be used and provides a number of examples that address the comments.

Issues of feasibility and the relationship to individual employers (as well as to the entire industry) are addressed in the CES narrative and supported by the rulemaking file, as are the specific hazard levels described by Appendix B. The comments about "least burdensome alternative" and "at least as effective as" requirements are addressed in the CES narrative and CES Appendix E.

*II.C. WISHA has exceeded its mandate by requiring employers de facto to address risks that are not work-related.*

The rule does not require employers to address risks that are not work-related. It is not necessary for the department to conclude that it can prevent all MSDs before adopting a rule. It is sufficient to conclude that many MSDs are caused or aggravated by hazards present in the workplace and subject to employer control and that reduction or elimination of those hazards will result in a substantial reduction in WMSDs. Based on an extensive record and a wide body of scientific knowledge, the department has reached exactly that conclusion. The analysis on which the conclusion is based is described in the CES narrative and supported by the rulemaking file. This issue is also discussed in Attachment 1 to this document, and a specific discussion of various papers by Dr. Bigos is provided in Attachment 5, by Dr. Nathan in Attachment 3 and by Dr. Hadler in the CES narrative. The NIOSH 1997 review and the NAS Report are discussed in the CES narrative.

*II.D. WISHA should postpone its rulemaking until the federal rulemaking is complete.*

The issue of whether to wait for federal rulemaking that may or may not occur is addressed by the CES narrative and in the comment response table in the CES.

*II.E. The proposal should at a minimum include a "safe harbor" provision modeled on California's ergonomics rule, which would partially address constitutional difficulties and would satisfy the "least burdensome alternative" requirement of the Washington Administrative Procedures Act.*

The department considered and rejected a "safe harbor" or "good faith" provision similar to the one in the California rule and explained its reasoning in the CES narrative. The final rule does, however, provide several "safe harbors" in the form of the "grandfather clause" for existing and effective efforts and in the form of the identified alternative

APPENDIX D2:  
SELECTED RESPONSES

measures under the general performance option. It also commits the department to working with labor and management to develop industry-specific “safe harbors” and share “best practices” on which employers will be able to rely to achieve compliance.

The department has completed a cost-benefit analysis and has determined that the benefits of the rule outweigh its costs.

The clarity of the final rule and the appropriate balance between specificity and flexibility it strikes are discussed in further detail in the CES narrative and are supported by the rulemaking file.

Conclusion:

The department has considered each of the assertions made in the UPS comments. L&I has made some modifications to the final rule that address UPS concerns and provide increased clarity and precision. However, the department rejects the conclusion that the scientific basis for regulation is not sufficient and that waiting for an uncertain federal response would provide appropriate protection for Washington workers.

### **Attachment 1: Response to Selected Comments Regarding the Science**

1. *"No conclusive scientific studies showing objective findings that there is a causal relationship between specific work activities and the development of complaints termed 'repetitive strain injury'" (page 3)*

Repetitive strain injury encompasses both clearly defined and less clearly defined health outcomes. Among the studies with more rigorous outcomes, the study of Kurppa et al. (1991), with a prospective design, shows clearly the work-relatedness of tenosynovitis/peritendinitis of the wrist forearm region and epicondylitis. These associations are supported by case-control studies, e.g. Roquelaure et al. 1997, Punnett et al. 2000.

2. *CTS is not presumptively work-related, current medical literature does not provide the information necessary to establish a causal relationship. Non-work-related factors more important than work-related factors. (page 4)*

The basis for these statements is that the most published prospective studies are those by Nathan et al. (see Attachment 3). Because of many serious flaws in the design analysis and the interpretation of the results of these studies, the evidence cannot be considered convincing. There are several cross-sectional studies (e.g. Silverstein et al. 1987), some of which used electrodiagnostic assessment (Latko et al. 1999, Stetson et al. 1993) and case-control studies (e.g. Roquelaure et al. 1997) that have addressed work-related factors with acceptable methods and show the work-relatedness of CTS. A prospective study in the pork processing industry showed slowing of median nerve conduction after an average of 64 days of employment (Kearns et al. 2000). Healthy worker effect in cross-sectional studies is likely to attenuate risk estimates, and therefore a positive association between a disorder and physical load factor from a cross-sectional study is noteworthy.

3. *Back pain presumptively not work-related, no reliable epidemiological evidence establishing lifting as a cause of back pain. Work-related factors explain little if any of the variation in disc degeneration and other structural changes of the spine. Nearly all studies conclude that there is no specific cause associated with back pain. (page 6-7).*

There are many studies that strongly suggest the work-relatedness of back pain, back disorders and structural changes (see table of strong studies). There are longitudinal studies on lifting and back disorders (Stobbe et al. 1988 and Venning et al. 1987) in addition to case-control studies (Punnett et al. 1991). The seemingly contradictory results from twin studies can be explained by the lack of exposure contrast in identical twins: it is difficult to find pairs that would pursue very different occupational careers when you have similar genotype and shared childhood environment.

4. *"Most cases of CTS do not have a clearly identified risk factor or cause.....in most 'surgical investigations'....no specific medical cause is identified" (page 8)*

The context of the quotation by Barbara Silverstein referenced here is that that most cases do not have a clearly identified risk factor in that CTS typically develops insidiously while performing regular work tasks. The lack of medical cause denotes the typical lack of underlying general disease (e.g. rheumatoid arthritis, renal or thyroid disease) among working populations (unlike clinical case series).

5. *"...in office settings -- where computers are widely blamed for carpal tunnel syndrome -- physical factors ...may be less important in their relationship than psychological factors with carpal tunnel syndrome" (Quotation of NIOSH report) (page 10)*

The strongest evidence between computer work and musculoskeletal disorders is for longer hours of intensive keying (e.g. Bernard 1994, Punnett and Bergquist 1997). Therefore this risk factor has been included in the rule.

6. *Role of psychosocial factors. Here, reference has been made to the Boeing study (Bigos et al. 1991), to a study by Linton and Kamwendo (1989), and to the study of Krause et al. (1998) (page 9-12)*

These three studies have been tabulated in Attachment 3 and there is also a larger analysis of the Boeing studies in Attachment 4. The study of Linton and Kamwendo has very serious flaws in not accounting for age and any physical work load factors at all, and the Boeing study did not assess physical work load factors in enough detail. The study of Krause et al. has been misstated in the sense that only the fairly modest results concerning psychosocial factors have been mentioned, but not those of physical load factors with higher odds ratios. The paper itself concludes that "...both physical workload and psychosocial job factors independently predict spinal injury in transit vehicle operators." Again, it should be noted that the outcome was spinal injury claim, and it is conceivable that psychosocial factors play a role, which, however, seems to be smaller than that of physical load factors.

7. *Iatrogenicity as a cause of reported CTDs (page 12-15)*

Here reference has been made to an Editorial by Cleland, to the comments by Brooks and Barsky, and a review "Functional Somatic Syndromes" by Barsky. Cleland points out how RSI has no underlying tissue damage, but is rather a disturbance of sensory function, which then with time is amplified by medical treatment protocols including rest and local therapies. Later, social iatrogenesis, e.g. in the form of educational programs that stress the seriousness of musculoskeletal symptoms and the influences of physical loads on the

musculoskeletal organs, may further complicate the situation. The Australian RSI epidemic and Swedish back pain epidemic are mentioned as examples.

These clinicians have their experience from treating clinical patient populations into which more complicated cases concentrate. These cases are not representative of musculoskeletal disorders at the workplace in general.

As regards the statement of no tissue injury behind RSI, there may be some cases where this is true. However, there is a solid basis in the literature showing associations between structural changes, objectively measured functional changes (e.g. conduction velocity of the median nerve), and physical workload factors.

8. *Effective Ergonomics Solutions Are Elusive. Citations of S. Snook, S Moore, Agency for Health Care and Policy and Research (AHCPR) Review (by Bigos et al. 1994), Linton and Van Tulder Review (page 29-32)*

Extensive data about effective solutions exist and are reflected in the CES narrative's discussion of technological feasibility and in the rulemaking file. A randomized controlled study, randomizing workers, or groups of workers, into those whose work will be changed or not, is very difficult to perform in a work environment; therefore such studies hardly exist. This is why L&I is relying most heavily on epidemiological evidence as the best available evidence.

*Comments specific to Washington State rule proposal*

9. *The Criteria at the Heart of the Proposed Rule are not "Widely accepted and Nationally Recognized. (page 35-40).*

There is a sufficient body of literature providing evidence on reference values and dose-response relationships. The number of papers has increased remarkably during the 1990s. For example, in the CES narrative, in table 7, providing specific evidence for caution zone job criteria, a reference was made 26 times to studies from 1990 onward, whereas older studies were referenced 11 times. In table 8, providing specific evidence for hazard zone criteria, a reference was made 50 times for studies published in 1990 or later, and 14 times for studies published earlier than 1990. These studies include a study to determine how well the NIOSH lifting equation identified jobs with increased risk of low back disorders (Waters et al. 1999).

10. *WISHA has exceeded its mandate by requiring employers de facto to address risks that are not work-related (page 43-46)*

The comments here take a rather circular nature. By asserting that any regulation must address factors outside work the commenters suggest that WISHA has done so and therefore exceeded its authority. They do not point to any portion of the rule that requires an employer to take any action outside of the workplace or to address any

risk factor or hazard that is not under the employer's control. By suggesting that other factors also may result in MSDs (an assertion already accepted by the department), the commenters suggest that reducing workplace risk factors cannot reduce MSDs. The logic is flawed and the conclusion does not follow.

The studies on which L&I has relied in defining caution and hazard zone jobs have accounted for the most important individual factors, and the risk estimates given express the independent effect of the risk factor in question. If a worker contracts musculoskeletal injuries in a situation where the employer is compliant with the rule, the rule does not make the employer responsible. L&I does not deny the importance of psychosocial factors in coping with everyday aches and pains or pain perpetuation.

- 11a. *WISHA's reference to the NAS report: "looking at studies with the highest level of exposure ...the positive relationship between musculoskeletal disorders and the conduct of work is clear" But the studies on which this conclusion was based were largely cross-sectional and hence incapable of demonstrating that work-place risk factors caused the supposed MSDs. (page 46)*

The studies that have performed a detailed quantitative analysis of exposure are largely cross-sectional, and do not as such serve for evidence of temporal association for a causal link between exposure and outcome. The temporal association has been shown in longitudinal studies, such as appear in Attachment 2. So, mostly a different set of studies will serve for the temporal aspects of causality and exposure-response relationships. This has been discussed also in Attachment 2.

- 11b. *NAS report states that the association between the conduct of work and MSDs was clear only when limited to the "studies involving the highest levels of exposure..." (page 47)*

This is true, but there is an earlier statement in the NAS report, saying "Strong associations between measured biomechanical stressors at work and musculoskeletal disorders were observed in most studies...however, the temporal contiguity ... could not always be established...This makes it difficult to make causal inferences on the basis from any individual study." A partial quotation out of context can in this manner become a misquotation.

- 11c. *Also the NIOSH review on which WISHA is relying is deeply flawed, especially in relying on studies on CTS that did not confirm the diagnosis by electrodiagnostic studies. A reference is made to Dean Louis, having stated "Reported...cases in the medical literature of ...a given entity such as the carpal tunnel syndrome are only permitted when appropriate supporting tests confirm the diagnosis, i.e. abnormal nerve conduction studies and/or electromyography." (page 47-48)*

While it is true that using electrodiagnostic studies, specific combinations of symptom characteristics and physical examination findings in combination



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provides the best analysis, there is no perfect golden standard for CTS. Recent studies and reviews have provided more information on the value of clinical tests (e.g. Tetro et al. 1998, Massy-Westropp et al. 2000). The department's conclusions are based on the entirety of a body of evidence, as reflected by the rulemaking file.

11d. *NIOSH study full of other flaws (page 48-49)*

The rulemaking file and the public record (particularly the comments by NIOSH) provide ample support for the NIOSH review and its conclusions. The sufficiency of the scientific record is also discussed in the CES narrative.

## **Attachment 2: Strong Studies on Causal Association**

This table summarizes a set of studies that provide especially strong evidence for causality. Because temporal relationship is essential for causality, longitudinal studies, preferably prospective, are important. In many of those studies, exposure assessment is based on job title or occupation, especially when the follow-up time has been long. This is because it is not possible to record intensities, frequencies and durations of physical load factors for months or years of exposure time for large populations.

The most convincing studies in the table are those that have utilized the best methodologies in exposure and outcome assessment and analysis.

For prospective studies on back pain, the study by Riihimäki et al. 1994 on sciatic pain is in the table. Other prospective studies are those by Pietri et al. 1992, Stobbe et al. 1988, and Venning et al. 1987.

The study of Kurppa et al. is a prospective study on wrist forearm tendinitis and epicondylitis in the elbow. Incident cases with the disease were those who sought medical care at the company occupational health service. This study has been carried out in Finland, where the medical and social benefits did not differ much depending on whether the case gets reported as an occupational disease or not. Therefore, affected workers are seeking

medical treatment more than economic benefit. It is generally hard to find a reliable and unbiased method to detect incident musculoskeletal disorders, and this study was considered among the best.

As regards disc degeneration and osteoarthritis, there is no perfect way to detect an incident case. Cross-sectional and case-control studies can be carried out. Also, the progress of degenerative findings is telling. The study by Riihimäki et al. with concrete reinforcement workers and house painters on radiographic disc degeneration, and the study by Luoma et al. using magnetic resonance imaging were included in the table as examples, because they were methodologically the strongest. There are several other studies on lumbar (Kellgren and Lawrence 1952, Hult 1954, Hult 1954, Biering-Sorensen 1985) and cervical (Kellgren and Lawrence 1952, Hult 1954) disc degeneration that confirm the findings in these two papers. As these studies are cross-sectional, they are less compelling by themselves than prospective studies. It would be hard to claim that subjects prone to degenerative disorders of the spine would be self-selected to manually strenuous tasks and stay there more than in less strenuous tasks. The association between heavy manual work and disc degeneration in the lumbar spine has been considered convincing (Riihimäki and Viikari-Juntura 2000).

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Table A. Examples of Studies Used in Assessing Causality						
Design	Study population	Outcome	Exposure	Main results	Comments	Reference
Low back studies						
Cross-sectional	216 male concrete reinforcement workers, 201 house painters matched for sex and age, participation rates 84% and 86%, respectively	Disc space narrowing (DSN), spondylophytes (SP), and endplate sclerosis (EPS) in plain lateral lumbar radiographs (Radiographs analyzed jointly by 2 radiologists, blinded for age and occupation; interexaminer repeatability found satisfactory in pilot study)	An average of 14.6 years of exposure to concrete reinforcement and 20.6 years to house painting work (minimum requirement 5 years)	Prevalence of DSN 28% and 15%, of SP 27% and 18% and of ES 11% and 6% in concrete reinforcement workers and house painters, respectively. Crude RR of DSN for concrete reinforcement workers vs. house painters 1.8 (95% CI 1.2-2.7), adjusted RR 1.8 (CI 1.2-2.5), for SP crude RR 1.5 (CI 1.1-2.2), adjusted 1.6 (CI 1.2-2.3). Earlier back accidents associated with DSN in univariate analysis, but did not retain significance in multivariate analysis	Adjustment for age, earlier back accidents, height, BMI, smoking in multivariate analysis. DSN: RR for age 6.5 (CI 1.7-26.0) (50-54 years vs. 25-29 years) SP: RR for age 14.9 (CI 2.3-94.7). DSN occurred at about 10 and SP at about 5 years younger age among concrete reinforcement workers than among house painters	Riihimaki et al. 1990
Cross-sectional	53 machine drivers, 51 construction carpenters, 60 municipal office workers, all males aged 40-45 years (participation rate 71%)	Decreased signal intensity, posterior disc bulges, anterior disc bulges in magnetic resonance imaging (MRI), assessed by 3 radiologists (interrater agreement acceptable, assessments of the most experienced	On average 26 years of exposure to whole-body vibration and prolonged sitting (machine drivers), dynamic physical work (construction carpenters), or sedentary work (municipal office workers)	Signal intensity not associated with occupation Posterior bulges most prevalent among carpenters at L3/4 disc (Unadjusted OR2.7 (CI 1.0-7.3)), when adjusted for confounders, no more statistically significant Anterior disc bulges most prevalent in machine operators at each level, remained significant at L4/5 and L5/S1 level in multivariate analysis	Adjustment for history of back accidents in one model, and for height, history of overweight, smoking and physical exercise in another model. (History of back accidents statistically significant for posterior bulges at L3/4 level)  Exposure was assessed both by job title and number of years in different types of work.	Luoma et al. 1998

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Table A. Examples of Studies Used in Assessing Causality						
Design	Study population	Outcome	Exposure	Main results	Comments	Reference
		radiologist used in the analysis			Results of these analyses similar, and therefore job title used in the analysis	
Prospective 3 years	1149 men with no sciatic pain at the onset of the study (387 machine operators, 336 carpenters, 426 office workers), mean age 37-38 years, response rate to questionnaire 79-89%	Incident sciatic pain (low-back pain radiating to a leg) by questionnaire at the end of 3-year follow-up	On average 13.3 years of exposure to whole-body vibration and prolonged sitting (machine drivers), 15.5 years to dynamic physical work (construction carpenters), and 9.0 years sedentary work (municipal office workers)	3-year cumulative incidence of sciatic pain 22% for machine operators, 24% for carpenters and 14% for office workers Crude RR 1.6 (CI 1.2-2.2) for machine operators vs. office workers and 1.7 (CI 1.3-2.4) for carpenters vs. office workers, adjusted RR 1.4 (CI 1.0-1.9) and 1.5 (CI 1.1-2.1), respectively (History of other type of low-back pain the strongest predictor, RR for mild pain 2.7 (CI 1.7-4.2) and for severe pain 4.5 (CI 2.7-7.6))	Health-based selection of workers at baseline, i.e. that only the most resistant subjects to back pain in the occupations with high risk will remain healthy, is likely to dilute the RRs between machine operators and office-workers and carpenters and office workers.	Riihimäki et al. 1994
Shoulder studies						
Cross-sectional	54 bricklayers, 55 rock blasters, 98 foremen, all men, participation rate 72, 73 and 89%, average age 50, 51, and 46 years, average years in occupation 28, 23, and 20 years	Acromioclavicular joint arthrosis on plain radiography, assessment by radiologist and orthopedic surgeon blinded to age and occupation	Job title, sum of load lifted during working years, years of manual work, sum of hours of exposure to vibration	Prevalence of osteoarthritis (grade 2-3) 59.3 and 40.7%, 61.8 and 56.4%, and 36.7 and 23.4% in the right and left side in the bricklayers, rock blasters, and foremen, respectively. ORs for bricklayers vs. foremen 2.2 (CI 1.1-4.1) and 1.8 (CI 0.8-3.9), and for rock blasters vs. foremen 2.1 (CI 1.0-4.6) and 4.0 (1.8-9.2). Dose-response relationship for years of manual work, lifted load, and vibration (ORs standardized for age)	A healthy worker effect is likely to dilute the results of this study	Stenlund et al. 1992

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Table A. Examples of Studies Used in Assessing Causality						
Design	Study population	Outcome	Exposure	Main results	Comments	Reference
Cross-sectional	As above	"Clinical entity of shoulder tendinitis" (pain in the shoulder last year + either pronounced pain on palpation of the muscle attachment or pain in isometric contraction, any of the four rotator cuff muscles). Analysis done also for signs of shoulder tendinitis	As above	Prevalence of clinical entity of shoulder tendinitis 1.8-1.8%, 14.5-23.6%, and 3.1-9.2% among the three occupational groups. For clinical entity of shoulder tendinitis, only vibration exposure statistically significant, for signs of shoulder tendinitis OR for highest vs. lowest category of vibration 2.4 (CI 0.9-6.3) on the right and 3.0 (CI 1.0-9.4) on the left side	Vibration seems to be a risk factor for shoulder tendinitis, the results being only borderline significant. Years of manual work and the sum of lifted load did not seem to be risk factors for shoulder tendinitis. The outcome, accepting palpation pain as objective finding, is not very strong	Stenlund et al. 1993
Case-control	79 cases and 124 referents (all except 4 were men) in the automobile assembly	Shoulder disorder (reported to the plant medical department and having had shoulder pain on more than 3 occasions or for more than 1 week the last year)	One typical work cycle was recorded on video for all study subjects. Shoulder posture was analyzed (neutral, mild flexion, severe flexion, total duration, percentage and frequency per cycle, right and left side separately). Peak reactive shoulder torques analyzed with a 3-	OR for severe (>90°) abduction/flexion 2.9 (CI 1.6-5.4) and 1.9 (CI 1.1-3.4) for all cases, and 3.2 (CI 1.5-6.5) and 2.3 (CI 1.2-4.8) for cases with physical examination findings (the two numbers are for exposures on right and left side, disorders on the right and left side were combined) Dose-response relationship for per cent of cycle time in severe shoulder flexion (none, <10%, ≥10% of cycle time)	The strength of the study is the objective exposure assessment and clinical assessment for both cases and referents. The higher ORs from the analyses using only clinically confirmed cases speaks for an association between the physical load factors and true disease. A drawback was that clinical examination was carried out on average 28 days after the case reported the disease to the plant medical department	Punnett 2000

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Table A. Examples of Studies Used in Assessing Causality						
Design	Study population	Outcome	Exposure	Main results	Comments	Reference
			dimensional biomechanical model			
Elbow disorders						
Prospective 2.6 years	102 male meatcutters (248 person years (py)), 107 female sausage makers (220 py), 118 female packers (253 py) and 141 men (334 py) and 197 women (456 py) in nonstrenuous tasks	Lateral or medial epicondylitis (tenderness to palpation at epicondyle, and pain in resisted extension/flexion of the wrist) verified for workers seeking medical advice because of elbow pain	Meat cutting, sausage making and packing are all highly repetitive jobs, meatcutting involving continuously and sausage making in some tasks high hand forces. The tasks of the packers mostly did not involve high forces. Packers were also exposed to cold work environment (8 to 10° C)	Incidence density of epicondylitis 6.4, 11.3, and 7.0 per 100 person years for the meatcutters, sausage makers, and packers, respectively, and 0.9 and 1.1. for the men and women in non-strenuous jobs	Incidence rates in meatcutters, sausage makers, and packers not directly comparable to those in non-strenuous tasks, because the physical demands of the job determine how much disability is caused by epicondylitis, and who will seek medical advice. Therefore, any incidence rate ratio is likely to be an overestimate of true risk. It is unlikely, however, that all differences between strenuous and non-strenuous tasks would be due to only seeking medical advice.	Kurppa et al. 1991
Wrist disorders						
Prospective 2.6 years	As above	Tenosynovitis or peritendinitis for the wrist or forearm region (swelling or crepitation and tenderness to palpation along the tendon and	As above	Incidence density of tenosynovitis/peritendinitis 12.5, 16.8, and 25.3 per 100 person years for the meatcutters, sausage makers, and packers, respectively, and 0.9 and 0.7 for the men and women in non-strenuous jobs	As above	Kurppa et al. 1991

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Table A. Examples of Studies Used in Assessing Causality

Design	Study population	Outcome	Exposure	Main results	Comments	Reference
		pain at the tendon sheath, in the peritendinous area, or at the muscle-tendon junction during active movement of the tendon)				
Cross-sectional	652 industrial workers	CTS, definition by symptoms and symptoms + signs	39 jobs allocated to 4 exposure categories (LOF-LOR, LOF-HIR, HIF-LOR, HIF-HIR) by walk-through (video-recordings and emg measurements for 3 workers per job)	Adjusted ORs for HIF-LOR, LOF-HIR and HIF-HIR vs LOF-LOR 1.8, 2.7 and 15.5, respectively (adjusted for age, gender, plant, and years on job)	The strength of the study is in the objective assessment of exposure and good contrasts between the different exposure groups. Outcome assessment by clinical examination	Silverstein et al. 1987
Cross-sectional	As above	CTDs (mainly tendon disorders) by clinical examination	As above	Adjusted ORs for HIF-LOR, LOF-HIR and HIF-HIR vs LOF-LOR 5.2, 3.3 and 29.1, respectively (adjusted for age, gender, plant, and years on job)	As above	Silverstein et al. 1986
Cross-sectional	352 workers in 39 jobs with a minimum of 6 months seniority in their job.	CTS by hand diagram, NCV, and hand-diagram + NCV	Repetition, force and posture assessed by observation, subjects allocated into 3 groups according to repetition	Prevalence of CTS based on hand diagram 6.8%, 14.5%, and 17.4% in the low, medium, and high repetition categories, respectively. Median mononeuropathy not related to the level of repetition. Prevalence of CTS based on hand diagram and median mononeuropathy 2.7%, 4.9%, and 7.9 (p=0.06)	The strength of this study is the selection of study groups to encompass jobs with varying levels of repetition. Both exposure and outcome with objective assessment	Latko et al. 1999

### **Attachment 3: Review of Studies by Nathan**

*Nathan PA, Meadows KD, Doyle LS. Occupation as a risk factor for impaired sensory conduction of the median nerve at the carpal tunnel. J Hand Surg [Br]. 1988 May;13(2):167-70.*

471 randomly selected volunteers were studied from four industries (steel mill, meat/food packaging, electronics, plastics), representing 26% of the overall working population of these industries. Median nerve function at the carpal tunnel area was measured electrodiagnostically as maximum latency difference (MLD). Physical work load was classified by one of the authors first according to type of grip, wrist position, handedness pattern, resistance, frequency and duration of grasp, and presence of vibratory and ballistic components. This primary classification resulted in 27 occupational categories which were then further grouped down to 5 categories according to amount of resistance and rate of repetition. These five categories consisted of a mixture of occupations, and were characterized by the authors as administrative/clerical (group 1), keyboard operator (group 2), assembly (group 3), general plant (group 4), and grinder (group 5).

Prevalence of impaired median nerve sensory conduction in these five groups was 28, 27, 47, 38, and 61%, respectively. Using a pairwise comparison between the groups, group 1 was found to have fewer subjects with impaired median nerve sensory conduction than group 5. They then looked at associations between bilateral conduction impairment and bilateral manual activities in job. For this analysis, they combined group 2 and 5 and 1, 3, 4 and found no difference between the two combined groups. The last analysis was to look at the associations between nerve conduction impairment and length of employment in the current industry, and no association was found. In this analysis all occupational categories were combined.

The authors conclude that impaired sensory conduction of the median nerve is a widely prevalent condition, and no consistent associations were found with the type and level of occupational hand activity.

This study has several methodological flaws both in the design and analysis of the results. Moreover, much important background information is missing. Below some examples are listed:

- The authors report that they selected randomly the study participants, but what proportion of those that they invited actually were studied is not reported. Consequently, there is no comparison between the participants and non-participants, and so the representativeness of the population sample is not known.
- The repeatability of the assessment methods for both median nerve impairment and occupational hand use were not studied.
- For a working population study, the differences in median nerve function in the 5 occupational groups are large, and any analysis thereafter should have taken into consideration the occupational category. The authors, instead, neglect these differences, and lump occupational categories with extremely different physical exposures to go on further in their analyses of the effect of bimanual activities and length of employment. The result is, expectedly, that no differences were found. For instance, for the result of no association



between length of employment and median nerve impairment, an evident explanation is that the subjects in physically strenuous occupations would leave their job because of their symptoms, whereas those in less strenuous jobs can usually go on with their work activities.

This study would be very important, as one of the few population studies addressing the associations between CTS or median nerve impairment and physical work load and reporting (at least the authors stress so) negative results. It is not an important study, however, due to its methodological flaws. Were the methods sound and the interpretation of the data correct, it could add to the literature reporting positive associations between CTS or median nerve impairment and physical work load factors.

*Longitudinal study of median nerve sensory conduction in industry: relationship to age, gender, hand dominance, occupational hand use, and clinical diagnosis.*  
*J Hand Surg [Am]. 1992 Sep;17(5):850-7.*

This is a follow-up study of the 1988 study population. 630 hands of 316 workers (67%) were followed from 1984 to 1989. Those employed less than 2 years attended the follow-up study less frequently (56%) than the rest of the original group (69%). Using hands as a unit of observation, the prevalence of impaired nerve function in the occupational categories changed, being the following for the 5 groups in the original 1984 sample: 15, 18, 28, 25, and 29%. The prevalences for the 67% study sample were practically similar. At the end of the 5-year follow-up the differences leveled out slightly. The authors report that there was a trend towards decreased nerve function impairment among those whose physical work load decreased. Nerve function impairment was also associated to age and hand dominance. The relationship with the occupational hand use category was only seen among women.

The authors conclude that they did not see major effects of occupational hand use on the prevalence of median nerve impairment. Also, the effects of age appeared slowly. Instead, hand dominance was the most powerful predictor, predicting together with age more than 90% of the variation in maximum latency difference. The overall conclusion is that non-occupational factors are more important than occupational factors in the causation of CTS.

The following comments can be made regarding this study:

- The participation rate and the representativeness of the original study population is not known, accordingly they are even less known for the follow-up population
- The analysis, using hands instead of subjects as the unit of observation, violates all basic assumptions for any statistical analysis. The two hands of one individual cannot just be lumped together in the analysis. The effect of lumping hands is clearly seen in the prevalence of impaired nerve function in the different groups: all prevalence figures are lower and the groups are now in different order according to prevalence. Also, the differences between groups are smaller, because the effect of one-sided median nerve impairment is smaller. The only acceptable analyses would have been one separately for the right and left hand, or for the dominant and non-dominant hand.

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- The main result of the follow-up is that the differences between the occupational groups get smaller. The authors quite correctly looked at whether this was due to less intensive occupational hand use, and their data suggest that this is the case. Still, the authors explain that the latter finding, being non-significant, does not explain the phenomenon.
- Hand-dominance emerging as the most powerful predictor is the result one would expect after the hands were lumped together. The authors discuss their results saying that “age and hand dominance in 1984 predicted more than 90% of the explainable variation in 1989 MDL, whereas occupational hand use in 1984 predicted less than 10%. Do these authors really think that people do not use their dominant hand for work activities?

The results of this study would look very different with a proper analysis, and as the previous study, could add to the existing literature on positive associations between median nerve impairment and occupational factors.

*Nathan PA, Keniston RC, Myers LD, Meadows KD. Obesity as a risk factor for slowing of sensory conduction of the median nerve in industry. A cross-sectional and longitudinal study involving 429 workers. J Occup Med. 1992 Apr;34(4):379-83.*

This study is based on the same study population as the two previous studies, and therefore shares the same problem of representativeness. Obesity is addressed as a risk factor, and the main result is a 3.5 to 4.1 fold risk of median nerve impairment for obese in comparison with slender workers. Again, the unit of observation was hand rather than individual, and work load factors were not taken into the multivariate model. Also, as obesity is an important risk factor for CTS, it should have been dealt with in the previous paper, where individual vs. occupational factors were specifically looked at.

*Nathan PA, Keniston RC, Lockwood RS, Meadows KD. Tobacco, caffeine, alcohol, and carpal tunnel syndrome in American industry. A cross-sectional study of 1464 workers. J Occup Environ Med. 1996 Mar;38(3):290-8.*

This study addresses the associations between median nerve impairment and the consumption of “legal drugs” (tobacco, caffeine, and alcohol). The recruitment of subjects is more than messy and the methods of data collection similar to previous studies. The authors find statistically significant associations between current smoking, current coffee consumption and CTS, but the results are meagre. The study, being cross-sectional, does not provide many clues for causation.

*Keniston RC, Nathan PA, Leklem JE, Lockwood RS. Vitamin B6, vitamin C, and carpal tunnel syndrome. A cross-sectional study of 441 adults. J Occup Environ Med. 1997 Oct;39(10):949-59.*

This study attempts to look at associations between median nerve function, CTS symptoms and plasma levels of vitamin B6 and vitamin C. The methods part is really messy:

The recruitment of study subjects is arbitrary with no real thought as to why certain groups were chosen. The subjects present 13 % of a potential source of subjects. The authors say that subjects with hand symptoms were overrepresented, and one can only imagine in what kind of biases this may result. They also included subjects with prior CTS surgery (31 subjects, 7.0%), rheumatoid arthritis (41 subjects, 9.3 %), thyroid disorders (26 subjects, 5.9 %), and diabetes (19 subjects, 4.3 %) in the analysis. All these disorders are known to affect nerve function, and the best way should have been to exclude these subjects, because there were too few of them to do a separate analysis. The authors, however, paid no attention to these conditions. Instead, 10 CTS patients using vitamins were treated separately!

This paper was later commented by Dr Franzblau et al, who stated that the design, analyses, and discussion are flawed, and the paper does not therefore provide any evidence on the relationship between vitamin B6 status and CTS. The authors could not adequately defend their study in their response (J Occup Environ Med 1998;40:305-9.)

*Nathan PA, Keniston RC, Myers LD, Meadows KD, Lockwood RS. Natural history of median nerve sensory conduction in industry: relationship to symptoms and carpal tunnel syndrome in 558 hands over 11 years. Muscle Nerve. 1998 Jun;21(6):711-21.*

This is an 11-year follow-up study of 578 hands of 289 subjects of the 1988 report study group. 67% of the original study group was examined 5 and 11 years after the baseline measurements. Impairment of median nerve function was measured as maximum latency difference (MLD) as well as two other electrodiagnostic methods. These other measurements were not performed consistently on every subject. Interviews about CTS symptoms were repeated. The authors hypothesized that the prevalence of impaired nerve function, CTS symptoms, and clinically diagnosed CTS would increase during the follow-up period.

At 5 and 11 year follow-up, hands cooler than 30°C were warmed, but this was not done at the baseline measurements. The nerve conduction measurements were adjusted according to the hand temperature with a mathematical formula. A structured interview technique was used to obtain information about symptoms, but it became more specific and more questions were asked during each subsequent study period. The authors write, however that “the primary criterion for abnormality in each study period was the presence or absence of certain specific hand/wrist symptoms”.

The authors report their results concerning nerve conduction slowing, symptoms of CTS and the diagnosis of specific CTS for all hands, female hands, male hands, dominant hands, and nondominant hands. They write: “The primary unit of analysis was the hand, because nerve

conduction findings and symptoms were side-dependent”. They also looked at the nonsymptomatic hands at baseline to see whether median nerve function predicted the development of CTS.

20 hands had undergone carpal tunnel release, 16 during the follow-up period and 4 before the baseline measurements. The analysis was performed first excluding these subjects and then including them.

There were 78 hands, for which genuine nerve conduction measures were not obtained. This happened in “large, callused hands of older, overweight individuals”. The missing values were “assigned the best estimate”. These subjects were retained in the analysis. At baseline, the authors had excluded 20 hands on the basis of not having obtained MLDs. A two-tailed p-value of 0.05 or less was considered statistically significant.

The results showed that nerve conduction impairment increased: prevalence of hands with nerve conduction slowing was 22.4, 30.1, and 43.0% at baseline, at 5-year follow-up and at 11-year follow-up, respectively. CTS symptoms decreased during the first period of follow-up and remained stable thereafter (prevalence 17.7, 12.4, and 12.9%). Clinically diagnosable CTS was fairly stable over the years (7.4, 7.2, 8.2%). These results apply to subjects without carpal tunnel release.

A closer analysis of the 78 hands in which maximum latency difference (MLD) was not obtained showed that these subjects were overweight or obese older males with more severe median neuropathy (by other methods of nerve conduction measurement). They often had thick calluses. The measurement typically could not be obtained at the site which had been the most likely to show slowing. It became more common over time not to obtain MLDs, and at 11-year follow-up this measurement was not obtained in 14% of the hands. 40% of subjects for whom MLD was not obtained in the follow-up were diagnosed with a systemic disease, such as diabetes or heart disease.

In the 464 initially asymptomatic hands, the probability of developing clinical CTS was strongly correlated with the initial MLD value. In the two groups with the highest MLD values in 1984, 20 and 32%, respectively, developed CTS during the follow-up.

The authors concluded that “changes in the conduction status of the median nerve occur naturally with increasing age,...and did not necessarily lead to symptoms. Most important, the majority of the workers we followed for 11 years did not develop median nerve slowing, hand/wrist symptoms, or CTS.”

This study has the following methodological flaws:

- The authors do give results for all hands and for dominant and non-dominant hands, which is improvement from earlier reports. However, saying that “The primary unit of analysis was the hand, because nerve conduction findings and symptoms were side-dependent” does not really make sense. One would do the analysis only by side after such a statement.

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- The measurement technique for MLD seems to vary from time to time, as the hands were warmed to be at least 30°C before the measurements were started at 5 and 11 year follow-up but not at baseline. It is uncertain how well this kind of basic background factor can be corrected for.
- If the main phenomenon under study cannot be obtained for some reason, it is very dubious to replace it by any method. That MLD was not obtained for a considerable part (14%) of the subjects at the end of follow-up is noteworthy. The facts with which the authors describe this group of hands raise even more suspicion. If these subjects were older, obese, showed nerve conduction impairment in other measurements, had calluses in their hands, and had developed diabetes or other chronic diseases, this might really be a subset of subjects with severe median nerve impairment. Accordingly they would have merited an analysis of their own as an interesting subgroup, and not having been substituted with “an estimated MLD” and kept together with the main group. These 78 hands together with the 16 hands that had undergone carpal tunnel release during the follow-up represent a pool of incident cases of CTS the analysis of which would have given valuable clues for the etiology of CTS. Diabetes, overweight, and calluses in hand, most likely as a result of tool use, give credible hints of etiology. But the authors merge these subjects with the remaining group in order to study “natural course”.
- The authors say that the structured interview became more specific and more questions were asked at follow-up than at baseline. This explains well the decrease in symptoms of CTS. The later interviews might have been better, but in a follow-up study the technique should have been the same in order to obtain comparable results. It is very likely that the overall prevalence of CTS being stable, despite more subjects with impaired median nerve function is largely due to changes in the interview. No other explanations seem to be available for the biologically implausible result of decreasing hand pain or paresthesiae by age.
- By analyzing all hands together, the assumptions for statistical testing are violated. The authors have a one-sided hypothesis in their Introduction, but use a two-tailed p value.
- The authors do not list anywhere what background information was collected and how systematically it was done. It is not therefore evident whether they asked all subjects about systemic diseases when follow-up measurements were done. It is evident that data collection should have been more systematic, and the data should have been much better cleaned before any analyses were carried out.

The authors say that they studied the natural history of median nerve sensory conduction, hypothesizing that it would worsen by age and lead to the development of CTS. But were they not interested in any background factors affecting the natural course but sex, hand dominance, and initial MLD value? And were they happy with the notion that most subjects did not develop CTS in 11 years? This last finding would be evident for everyone.

What is more serious that even the natural course, the main focus in this study, seems not to be reported well. The results suggest that several subjects developed median nerve impairment during the follow-up, but this result is almost swept under the carpet. Based on the description of

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the interview methods, it is not really credible that the subjects became less symptomatic. Description of the groups with severe findings might have been informative as regards the etiology of median nerve impairment.

The authors discuss that they did not specifically address the effect of occupational hand use, and conclude that as the development of CTS was not common, it is unlikely that occupational hand use would be a significant contributor to their results, which is in accordance with their earlier results. The authors could at least have recorded whether the subjects were still occupationally active and whether they had the same occupational category as before. Moreover, where do the authors believe that calluses come from, if not tool use?

**Attachment 4: Review of Studies about Psychosocial Factors**

Design	Study population	Outcome	Exposure	Main results	Comments	Reference
Cross-sectional	438 female medical secretaries, mean age 39 (range 19-64)	Pain in neck, shoulder, back, discomfort in neck, shoulder	Not assessed	OR of neck pain 2.9 (CI 1.3-6.3) for good vs. poor experienced psychosocial work environment, for shoulder pain OR 3.3 (CI 1.5-7.2)	No adjustment for age, although age range 45 years! Physical work exposures not considered in the analysis Results could well be confounded by age or other work exposures than psychosocial Also, health endpoint any pain or trouble during a long period of time with prevalence of 63% for the neck and 61% for the shoulder. It is conceivable that recalling such minor discomfort could be associated with psychosocial factors, once confounding by above mentioned factors could be ruled out	Linton and Kamwendo 1989
Prospective 6 months	137 patients of 19 primary health care clinics with acute or subacute pain from the back or neck area	Accumulated sick leave during follow-up time by postal questionnaire	"Heavy or monotonous work" and the following individual factors: background, physical functioning, fear-avoidance beliefs, experience of pain, reactions to pain	The strongest predictors of sick leave were fear-avoidance work beliefs, perceived improvement, problems with work function, stress, and previous sick leave	The question on work load "heavy or monotonous work" encompasses two completely different axes of load, and can therefore combine physically strenuous tasks, possibly including manual material handling, and very light tasks that are just "monotonous" in the same category. It is therefore no	Linton and Halldén 1998

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Design	Study population	Outcome	Exposure	Main results	Comments	Reference
					wonder that this variable had no predictive value.	
Prospective 4 years	3020 aircraft manufacturing workers, 75% participation rate in the beginning and 40.5% at the end of the follow-up.	Reporting back pain at company medical department or filing a back injury claim (via company medical department or personal physician	Heavy and tiring tasks were assessed in terms of maximal load on the spine based on a biomechanical model (not described in enough detail). This analysis was done for all jobs employing more than 19 people. Also perceived physical exertion was inquired	Predictors for back injury reports were "not enjoying tasks involved in one's job (OR 1.7, 95% CI 1.3- 2.2), scale 3 (hysteria) in MMPI (OR 1.4, CI 1.1-1.7), and prior back pain (OR 1.7, CI 1.2-2.5) The corresponding numbers for those without prior back pain were OR 1.5 (CI 1.1-2.3) for not enjoying job, and 1.4 (CI 1.2-1.7) for hysteria in MMPI	Low participation rate, Assessment of physical loads not carried out on individual basis, also method of analysis not described well in the paper. Range of physical loads not ideal for studying effects of high physical loads. As the outcome is report of back injury or back injury claim, it is easy to understand that psychosocial factors play a role	Bigos et al. 1991
Prospective on average 3.3 years	1449 transit vehicle operators	Workers' compensation claim due to strain, sprain, contusion, or pain in the spine (about 2/3 were in the back)	Duration of employment as transit vehicle operator, average weekly hours, overtime hours, vehicle type (diesel-bus, trolley-bus, light-rail, or cable car) Psychosocial job characteristics (decision latitude, psychological demands, job dissatisfaction, coworker support, supervisor	Predictors for spinal injury claim were short duration (0-5 years) of professional driving (OR 6.1 CI 4.1- 9.1), and driving a cable car (OR 3.0, CI 1.9-5.0). Driving 20-30 hours/week vs. 31-40 was protective (OR 0.4 CI 0.2-0.9). Of the psychosocial factors, high psychosocial demands and high job dissatisfaction predicted spinal injuries (ORs 1.5 (CI 1.1-2.0) and 1.6 (CI 1.1-2.2), respectively; high frequency of job problems and low supervisor support were borderline significant.	Both physical work load factors and psychosocial factors predicted spinal injury claim, risks being greater for physical load factors. Cable car operators need to push and pull mechanical levers, often associated with trunk bending, while standing most of the day. As a longitudinal study with subjects that had a 12.8 year mean exposure time, there probably is a survivor effect which partly explains why shorter duration as operator	Krause et al. 1998



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Design	Study population	Outcome	Exposure	Main results	Comments	Reference
			support), frequency of potentially stressful problems		involves increased risk of injury	
Cross-sectional, Job history retrospective	85 monozygotic (identical) twin pairs discordant in exposure to risk factors of spinal degeneration (physical work load, leisure activities, vehicular driving, smoking)	Thoracic and lumbar disc degeneration on magnetic resonance imaging (MRI): quantitative assessment of signal intensity of the disc, qualitative assessments of signal intensity of the disc, disc height, and disc bulging/herniations	Lifetime job history (job tasks and different loading situations), lifetime leisure activity history, assessment of intragenic polymorphism in the vitamin D receptor gene (VDR), more specifically in TaqI and FokI alleles	Quantitatively measured signal intensity associated with polymorphism in TaqI and FokI alleles both at T6-T12 and L4-S1 discs Qualitatively assessed disc bulging scores at T6-T12 level also showed a similar association with TakI alleles, but in the lower area (T12-S1) in an opposite way. Only summary of qualitative scores associated with FokI genotypes. Occupational loading, power sport participation, and smoking did not confound this association. Overall, genetics and shared environment (twinship) explained 71% of the variability in quantitatively measured age-adjusted signal intensity in the T6-S1 discs. The TakI and FokI polymorphism accounted for 6.5% of the interindividual variation of signal intensity	The results of this study have been used to emphasize the importance of individual, especially genetic factors, and the non-importance of occupational loading, on disc degeneration of the spine. It has to be understood that, using a material of identical twins with identical genome and shared childhood environment, one cannot expect extreme variation in career paths and occupational loading. This means that this study is likely to lack in occupational contrasts. The other factor is that all individual factors are accurate measurements whereas occupational loading was an estimate for lifetime based on interview and is likely to involve much more error. Error in estimate usually attenuates risk estimates. These two factors do not invalidate this study, but they explain why these results cannot be	Videman et al. 1998

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Design	Study population	Outcome	Exposure	Main results	Comments	Reference
					generalized to working populations in general.	

The above table lists some examples that have been used as examples of no evidence between musculoskeletal disorders and physical work load factors. The associations between human genes and musculoskeletal disorders is a fairly new and expanding area of research. Videman et al. study has been taken as an example. Another study among patients with intervertebral disc disease showed a change in a gene coding type IX collagen. This change was present in 4% of the patients with intervertebral disc disease and in none of the controls (Annunen et al. 1999). A third study found an association with early knee osteoarthritis and TaqI polymorphism (Keen et al. 1997).

### **Attachment 5: Review of Studies by Bigos**

*Bigos SJ, Battie MC, Spengler DM, Fisher LD, Fordyce WE, Hansson TH, Nachemson AL, Wortley MD. A prospective study of work perceptions and psychosocial factors affecting the report of back injury. Spine. 1991 Jan;16(1):1-6.*

3020 workers of an aircraft manufacturing factory were included in a prospective study of reported low back pain. About 75% of those solicited volunteered. A questionnaire about demographic and psychosocial aspects was returned by 1569 workers (54% of those volunteered for the study and 40.5% of the original study sample). Subsequent reporting of back injury did not differ between those who returned or did not return the questionnaire. The back injuries were tracked during four years via the company medical department and industrial insurance claim reports.

Basic demographic information, such as education, marital status, work history, and previous back complaints were collected by the questionnaire. The questionnaire included also Minnesota Multiphasic Personality Inventory (MMPI) that has been mainly in clinical use with back pain and chronic pain patients. The questionnaire includes questions with the aim to assesses personal or psychological traits according to 11 clinical scales, for example hypochondria, depression, hysteria, anti-social feelings, etc.

A family APGAR, a brief six-item family function questionnaire was included as well, as a modified work APGAR that was used to examine perceptions and support at the workplace. The work APGAR had been used in the previous retrospective studies in the company.

Questions on health locus of control were included to measure beliefs and expectations as regards health and well-being.

Physical work load factors were taken into account by assessing heavy and tiring tasks in terms of maximal load on the spine based on a biomechanical model. This analysis was done for all job types employing more than 19 people. Also perceived physical exertion was inquired.

In preliminary analyses, current back pain in the beginning of the follow-up or back pain that had caused work loss in the prior 6 months was the strongest predictor of future back pain. Other associations were found for some work APGAR items and some MMPI scores. The final multivariate model showed the highest risks of back injury for prior back pain, “not enjoying the tasks involved in ones job” in the work APGAR questionnaire, and hysteria in MMPI (tendencies toward somatic complaints or denial of emotional distress). For those without a history of back injury, the risk associated with the work APGAR was smaller. Those reporting a back injury tended to be younger, but age did not predict back injury in the final model. Work conditions and other demographic variables did not predict back injury.

The authors conclude that the predictive power of work perceptions and psychosocial factors was statistically significant but clinically modest. However, these aspects should be taken into consideration in future studies on low back problems in industry.

There are several factors that prevent us from generalizing these results to back problems in industry.

- The participation rate is low: Of originally solicited subjects about 75% volunteered, but of these, only 54% returned the questionnaire; accordingly the participation rate of the original sample is 40.5% and the number of subjects in the analysis 1569. The authors reported that this population did not differ from those not returning their questionnaires with regard to reports of back injuries. No information is available how these two populations differed with regard to the predictors, such as demographic and psychosocial characteristics and work load characteristics. Not enough is known about the representativeness of the study sample.
- The phenomenon under study is a report of back injury. This is different from perceived back pain or other trouble, and also different from a specific or less specific back disorder or disease. It is generally believed that the role of physical vs. psychological or work organizational factors is not similar for the disease (tissue damage) and the reporting of it. Most researchers believe that the role of psychological and work organizational factors becomes greater once the tissue injury has occurred. Also the results of this study, i.e. the risk ratio of the work APGAR being higher for those with previous back problems than for those without, support this interpretation. These results of this study are therefore not directly applicable to back pain or disorders at work places in general.
- The assessment of physical work load was far from ideal: Only the most prevalent jobs were analyzed and those only for maximal load on the low back. This means that there were no very accurate data on physical load factors at individual level. Inaccuracy or error in exposure assessment tends to attenuate the risk estimates. It is therefore possible that the actual physical loads and the associated risk remained undetected in the study.
- There were no physically very demanding jobs, and the range of physical loads on the low back was therefore not ideal to see effects of such loads. The authors do mention this in their Discussion. They also admit that their results may not be applicable to physically strenuous jobs.
- Another bias inherent in the fact that the assessment of physical loads was not ideal, whereas many individual characteristics were measured with much better accuracy, is that the risks for the individual characteristics were most likely emphasized. Many studies probably share this problem and it is not until recently that researchers have started to pay attention to this. The authors of this study admit that the work APGAR and MMPI Hysteria scale, although statistically significant predictors, had only modest practical significance.
- That previous back injuries or pain at the time of replying to the questionnaire was a strong predictor is nothing new. It can be said that the study would have been stronger if it had been designed to include only subjects without prior back injuries. The effects of previous physical work load factors may have been reflected in previous back injury reports, and therefore the inclusion of this latter variable may have prevented seeing risks due to physical work load factors.

*Battie MC, Bigos SJ, Fisher LD, Spengler DM, Hansson TH, Nachemson AL, Wortley MD. The role of spinal flexibility in back pain complaints within industry. A prospective study. Spine. 1990 Aug;15(8):768-73.*

This study looks at measures of spinal flexibility as predictors of reported back injuries.

The tests had no predictive value with regard to future back problems. An association was found with current and previous back problems.

This study has the same design, but it does not use the questionnaire information on psychosocial factors. The participation rate of this study is 58% of the original sample.

*Bigos SJ, Battie MC, Fisher LD, Hansson TH, Spengler DM, Nachemson AL. A prospective evaluation of preemployment screening methods for acute industrial back pain. Spine. 1992 Aug;17(8):922-6.*

This report looks at the predictive value of clinical tests and demographic data from the questionnaire as predictors of back injury reports. Looking at one variable at a time, a couple of clinical tests seemed to have predictive value, but when previous back treatments and workers compensation claims were entered together with these variables into a multivariate model, none of the clinical variables had predictive value. Most variables on past treatment of back injuries had some predictive value.

*Bigos SJ, Battie MC, Spengler DM, Fisher LD, Fordyce WE, Hansson T, Nachemson AL, Zeh J. A longitudinal, prospective study of industrial back injury reporting. Clin Orthop. 1992 Jun;(279):21-34*

This study seems to be an overall report that used all available data, i.e. demographic variables, medical history, workplace factors, job perceptions, psychological factors, anthropometric measurements, clinical examination data, and measurements of physical capacity to predict reports of back injuries. Statistically significant variables in the final multivariate model included job satisfaction, number of doctor visits, previous chiropractic treatment, one clinical test (back pain on straight-leg-raising), and MMPI hysteria scale. The authors present Venn diagrams showing that the relative amounts of information for predicting back problems are 3.3% for medical history, 2.2% for job satisfaction, 1.9% for psychological factors, and 1.2% for physical examination. Together, these variables predict 7% of the variability in back injury reports.

Overall the Boeing prospective study does not increase much our understanding on back disorders in industry. The results can be considered meagre; some variables reach statistical significance but they do not explain much of the variability of the phenomenon under study. Not

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all predictors of interest have been assessed with equal rigor. That previous back trouble predicts future problems has been known for years.

Altogether eight papers have been published on the prospective part of the Boeing study. The papers give somewhat different results, because different groups of predictors were included in the analysis in each paper. One really questions whether the analyses, and way of reporting were ideal. The authors should have been able to reach a final multivariate model with a somewhat shorter exercise. This would have saved much effort for a reader looking for new knowledge.

### **Attachment 6: Response to Comments about Weight Limits in Appendix B**

*Point 1: NIOSH lifting equation ignores factors such as load stability, personal strength, fitness, age, gender, training, noise, and temperature even though the NIOSH guide suggests that they have some effect on the load handling safety.*

It is true that the NIOSH lifting equation may be either an under- or over-estimate of the risk of low back pain or injury depending on these factors. However, establishing limits based on some factors such as age and gender would most likely result in hiring biases that the department does not intend to promote. Nor does the research support the “common sense” theory that older females are at greater risk of developing low back pain or injury. Other factors such as strength, fitness, and training are difficult to measure accurately, require specialized equipment, and would significantly increase the complexity of the evaluation method. In order to provide employers with a relatively simple tool that can be used in short time, without special equipment, the Department decided to base the lifting analysis on the 1991 NIOSH lifting equation.

*Point 2: NIOSH guidelines are "most limited" when applied to "highly variable jobs" such as "warehousing, shipping, and receiving activities where there are many different sized loads and varying weights that are lifted at varying frequencies"*

Although using the NIOSH lifting equation to analyze high frequency, variable lifting tasks increases the complexity of the analysis, it is still possible to use the composite lifting index. This is done by computing the frequency-independent lifting index for each lifting task. Appendix B's heavy, frequent or awkward lifting task analysis in the final rule is based on the 1991 NIOSH lifting equation. Although it does not include information of how to calculate the composite lifting index, information is provided on how to calculate the weight limit for frequent, variable tasks by analyzing the two worst case lifts and the most commonly performed lift.

*Point 3: The results of Lavender, et al (1999) show that the outcome of an ergonomic job evaluation for LBD risk depends on the method used for that evaluation*

Even though the Appendix B-Heavy, frequent or awkward lifting task analysis is based on the NIOSH lifting equation, the recommended weight limits are higher than what NIOSH would consider a low risk task. In the Lavender et al study (1999), when comparing the NIOSH lifting equation to the other methods, a lifting index of 1 or below was categorized as low risk. Therefore, it is difficult to compare the proposed weight limits in Appendix B to the results of Lavender et al, since Appendix B values are based on lifting indexes between 1.4 and 2.0. Based on the weight of the evidence, the department has concluded that these limits are most appropriate for those employers that choose the specific performance option.

*Point 4: Liberty Mutual's lifting tables are based almost entirely on workers' psychophysical appraisal of the maximum acceptable weight of lift rather than studies aiming to determine the circumstances under which lifting cause physical harm.*

We agree there are discrepancies between the Snook, psychophysical data and the NIOSH lifting equation and have decided to remove the Snook reference.

*Point 5: In our industry of delivering goods to consumers (trucking) there are situations where there is not any way to do the job except raw physical exertion*

In those cases where there is truly no technologically and economically feasible means for reducing the risk factor below the level in the standard, the employer is allowed to continue those tasks and must only reduce the hazards to the extent feasible. In the case of trucking, there are a number of controls and methods that can reduce the hazard, even where it may not be possible to fully eliminate it.

Point 6: The NIOSH Lifting Equation would have us believe that a lift of 40 inches (resulting in a recommended weight limit of 4.78 lbs.) is less difficult than a lift of only 1 inch that begins 1 inch closer to the ground (resulting in a recommended weight limit of 0.00 lbs.).

In order to simplify calculations, the NIOSH lifting equation uses discrete rather than continuous categories when determining the multipliers. While the equation works well in most cases, extreme cases such as the very high frequency of lifting used in this example will result in comparative numbers that, at face value, do not make sense. Functionally, this is less of a problem, since the equation would correctly classify highly repetitive lifting done for an entire workday to be a potential hazard in both of these examples. This is especially true of the first example, where a worker is expected to lift an object once every six seconds from mid-thigh to above the head for an eight hour shift. However, the lifting analysis method in Appendix B avoids some of these problems by using a different set of discrete categories that are more intuitive. In fact, in the example used, the analysis in Appendix B would return the same results for both lifts, essentially that both are hazardous due to the extreme repetitiveness of the task.

*Point 7- A similar analysis to that from point 6 using the 1981 NIOSH lifting equation gives a result indicating that lifting an object 40 inches is safer than lifting it one inch.*

The 1981 NIOSH lifting equation, which is very different from the 1991 lifting equation, was not used in the development of the rule.



### **Response to Comments by Rodney Smith (Freeborn and Peters)**

The department has analyzed and responded fully to the comments by Rodney Smith and the attachments to his comments prepared by Michael Smith and Ben-Tzion Karsh. The department response may be found in four places: this summary and its attachments, the CES narrative, Appendix D to the CES. This summary follows the sequence of Mr. Smith's comments.

This summary is accompanied by two attachments:

Attachment 1: Response to Submissions by Michael Smith and Ben-Tzion Karsh

Attachment 2: Strong Studies on Causal Association

1. *The “caution zone job” criteria to determine coverage are overly burdensome.*

The comments state that many caution zone jobs do not present significant hazards. The department agrees. However, the department disagrees with the further assertion that because not all caution zone jobs constitute hazards they do not warrant the two prudent, cautious steps required by the rule – awareness education and further job evaluation. The CES narrative describes the department's rationale more fully

The comments state that determining whether a job is in the caution zone is an overwhelming, never-ending task that should only be done by an ergonomist. The criteria are described simply and can be applied by average lay managers, supervisors, worker representatives or employees. No special equipment or technical training is intended or required. The rule makes clear that the department expects employers to make reasonable determinations. The final rule clarifies that activities must occur on more than one day a week and more than one week a year to be covered. The final rule also clarifies that duration refers to the total amount of time per day employees are exposed to the risk factor, not how long they spend performing the work activity that includes the risk factor. The CES also clarifies that representative sampling is acceptable and describes acceptable methods for determination of caution zone jobs in construction.

The comments are correct that a job may change from one month to the next and become a caution zone job or a hazardous job when it was not one previously. This supports the department's decision to make the criteria as simple as possible.

These comments are discussed more completely in the CES narrative and CES Appendix D.

2. *WISHA's “general performance” and “specific performance” approaches to job analysis and control are unworkable and will commit employers to costly and needless job fixes.*

The comments state that the general performance option is flawed because no one has been able to establish a causal link between specific risk factors and a substantial risk of WMSDs. L&I believes that there is a compelling body of scientific evidence that does establish such links between exposure and WMSDs. This is discussed in detail in the CES narrative, the attachments to this summary and other documents in the record.

The comments state that the term “effective” with regard to “widely accepted nationally recognized criteria” was not defined. The department agrees. The final rule eliminates the term “nationally recognized” in favor of “widely used.” It also makes clear that effectiveness means “as effective as the recommended levels in widely used methods,” a concept and test that is more clear and practical than the proposed version.

The comments state that the rule will require “a never ending and costly ‘black hole’ of controls” by committing employers to “bring all of its ‘caution zone’ jobs into compliance.” This is incorrect in two ways. First, there is no requirement to bring all caution zone jobs into compliance because many of them will be determined not to pose hazards and therefore not to be out of compliance. Second, hazard control is not an endless task. When exposures are reduced below the defined hazard level the employer is in compliance and finished, unless the job changes in the future.

The comments state that the rule will force employers to increase staffing so as to reduce duration of exposure. The final rule clarifies that employers are not required to replace full time with part time employees or otherwise reduce an individual’s hours of employment to be in compliance.

The comments state that the rule is so specific that it precludes the use of professional judgment and thereby reduces flexibility. The department has considered this view and disagrees. The rule is specific in its criteria for identifying caution zone jobs but otherwise provides ample opportunities for employers to choose their own methods for analyzing jobs and controlling hazards. Appendix B is offered only for those employers who do not want to take advantage of this flexibility. The fact that the rule is designed so employers in most cases can make choices and decisions themselves and will not have to hire expert consultants in no way bars employers from doing so if they so choose.

The comments question the department’s preference for engineering and administrative controls. The department believes that measures that rely primarily on human behavior are inherently less reliable and protective. This concept of a hierarchy of controls has been widely used and accepted in occupational safety and health for many years. This issue is discussed further in the CES narrative. The comments are incorrect in stating that if an employee is using a tool or piece of equipment incorrectly the rule would require the employer to purchase or install a different tool or piece of equipment rather than train the employee how to use the existing one correctly. The rule specifically requires job specific training for the proper use of hazard control technology.

3. *The “grandfather” clause is meaningless*

The comments question whether employers will be able to know if their programs are effective unless they first implement the requirements of the rule for comparison. However, the basic requirement of the rule is to identify hazardous exposure levels and to reduce exposures below these levels. This means that effectiveness can be measured readily. An

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employer who establishes appropriate control levels and adheres to them before the rule is adopted will be entitled to continue his or her program.

4. *Submissions by Michael Smith and Ben-Tzion Karsh*

These are discussed in the attachments to this summary.

These comments and its attachments are discussed in more detail in the CES narrative, CES Appendix D and other documents in the record.

### **Attachment 1: Response to Submissions by Michael Smith and Ben- Tzion Karsh**

*Caution zone jobs: Knows of no validated criteria that single risk factor constitutes a hazard subject to further training, job analysis and control*

The commentor misunderstands the purpose of the caution zone determination. The rule clearly distinguishes between caution and hazard. Exposure to multiple risk factors at the same time increases risk and requires more detailed assessment. The purpose of the caution zone is to give employers who have minimal exposures an easy way out and those that have more employee exposure the opportunity to involve workers in determining whether there are hazards that need to be reduced. Employers familiar with the jobs in their workplace can more readily assess whether they have caution zone jobs than an outside consultant who does not know the jobs. This requires a quick, reasonable determination, not detailed analysis. Help materials will be available to guide employers in quick determinations. The caution zone risk factors are explicit as requested by the advisory committees who don't want to guess what "awkward posture" means or when it is a concern. The alternative is to merely have employers identify all jobs with awkward postures, high forces, etc. with no clear guidance on what is meant by these terms. This would lead to considerable confusion by all parties. As a side issue, there are a number of studies that identify high risk exposures to one risk factor depending on duration, intensity and frequency of exposure (examples can be found in the CES tables 7 and 8).

#### *1. Value of the general performance approach*

The department listened to employers from different industries and different sizes in which some indicated the need for specific criteria and others wanted flexibility to determine their own approach to hazard recognition and control. This was provided in the rule. There are a number of approaches that have been used in doing so, depending on the nature of the exposures. For example, Lavender points out that use of the NIOSH lifting equation works for jobs involving moderately frequent lifting, but physiological criteria are more useful for highly repetitive manual handling jobs and 2 or 3D static strength biomechanical models are more useful for low frequency high loads particularly with awkward postures. Under the general performance model, employers may use those methods that most adequately address their exposures. Likewise, psychophysical tables may be used to design to the population and the task. As Snook noted in 1978, and Liberty Mutual Loss Control Managers have advised, designing manual handling tasks that at least 75% of the population, and preferably 90% of the worker population will find acceptable, will reduce manual handling related injuries. These methods have been around for a long time. The rule does not prohibit or require the use of professional ergonomists. However, professional ergonomists should be familiar with relevant exposure assessment methods.

#### *2. grandfather clause*

If employers have already provided training and analyzed their jobs that would fit in the caution zone, they do not have to start all over again. This is the point of the grandfather clause.

Responses to Michael J. Smith's Comments

[NOTE: Dr. Karsh is not an epidemiologist. Dr. Smith is relying on Dr. Karsh's review of the epidemiological studies in Bernard 1997, etc.]

Dr. Smith claims there is not a sufficient body of evidence to establish dose response relationships among exposures and specific medical conditions defined as WMSDs. He notes that pathomechanisms have not been completely determined. He does not believe it is possible to define duration of exposures that produce specific responses, therefore the department should not define specific level of exposure as hazardous or safe. He states that there are no studies backing up caution zone levels. And he notes that ergonomic risk cannot be defined and controlled by looking primarily at engineering factors to the exclusion of behavioral and personal factors.

First, as epidemiologists know, it was more than 25 years after John Snow took off the handle to the Broad Street Pump in London, before the cholera vibriovirus was identified as the cause of the cholera epidemic sweeping London more than 2 centuries ago. He did this after looking at the patterns of association between where people went for their water and where there was sickness. These same basic epidemiological principles have been applied in the area of musculoskeletal disorders and work factors. There is no doubt that both work and non-work related factors contribute to the development, aggravation and disability from musculoskeletal disorders. We do not currently know the exact number of repetitions combined with specific newtons of force or specific degree of wrist angle that will be safe for all workers in all circumstances. At the same time, that should not prohibit us from taking public health action on the basis of the best available information. We have looked at laboratory and epidemiological studies to identify those levels of workplace exposures that the literature has identified as increasing risk. As with other health standards, at such time as more precise information becomes available, the department can review the new studies and determine if the existing rule should be modified. In establishing the caution zone levels, the department relied on the available studies in the literature and practical application of that information for most employers. For example, there are a number of studies that demonstrate exposure-response relationships between levels of exposure to whole body vibration and lumbar and cervical disorders. However, because of the complexity of measurement, with no easily identifiable surrogates, we were unable to identify a practical way to require employers to determine if there were hazardous WBV exposures. Similarly, there are good exposure-response studies for Hand Arm Vibration and there are some surrogate measures that employers can use to estimate hazardous exposures. Therefore, hand arm vibration is included in the ergonomics rule.

We agree with Michael Smith that jobs are an integration of many work demands that taken together produce loads on the body and mind and that no single job exposure can define the entirety of the risk for developing WMSDs. However, we have chosen to address those most commonly reported factors that employers can address in the workplace to reduce the work-related components of that load. Although a number of studies have identified social and psychological factors - such as perceived high job demands with little decision latitude and low social support-- with WMSDs, the associations in general have been less strong in the initial stages of the WMSD process and appear more strongly in the secondary and tertiary stages of treatment and disability (see for example {Krause, Ragland, et al. 1998 #27340} or {Kerr, Frank, et al. 2000 #27850}). The focus of this rule is the prevention of WMSDs in the workplace. There

are many fewer studies reporting the effects of psychological and social interventions in the workplace, in the absence of changes in physical workload, than there are on changes in physical workload affecting WMSD incidence, prevalence and severity. This is not to say that work organization issues are not important in providing a healthy workplace. Likewise, there are a number of personal factors that contribute to the development and aggravation of WMSDs. However, some of those factors are not modifiable and others such as obesity go beyond the department's authority to address. Work habits and work methods can be addressed in controlling hazards. That is why worker awareness education and involvement in the identification and control of hazards is important.

Dr. Smith argues that it is inappropriate to identify specific factors that require control (e.g., high hand force or overhead reaching, etc.) because in the epidemiological studies, most likely there were multiple risk factors and it is artificial to separate them in the analyses. We are not able to guess what the risk factors were that were occurring simultaneously in the studies Dr. Smith is referring to if the authors did not describe them as such.

The department is not obliged to wait until definitive dose response curves are available to act to protect workers. Rather, the department is required to make a reasonable determination based on the best available information and not wait until there is scientific certainty before taking action to protect workers. Rather than having employers guess about what is meant by "awkward postures" or "high hand forces," we chose to provide specific numbers. A summary of the epidemiological studies we reviewed in making the determinations we did are provided in the CES. A number of other commenters provided different assessments of the literature than Dr. Smith (See comments of Gerr, Armstrong, Lavender, Keyserling, Punnett, Norman) and gave very specific comments about levels rather than sweeping statements such as Dr. Smith's.

- Drs. Smith and Karsh dismiss epidemiological studies in which either exposure or effect is self-reported. They take the criteria in the NIOSH review (Bernard, 1997) and add more criteria on to it and mechanically disregard studies. This is a mistake made by non-epidemiologists. As noted by Dr. Wegman in the NAS workshop proceedings (NRC, 1999), a qualitative review of the literature is critical to increasing our understanding of phenomenon for the prevention of disease. Rather than arbitrary dismissal, studies should be reviewed to find what is useable in them. Those components that bias some findings may not bias others. Wegman cites Checkoway's text on occupational epidemiology in discussing causal inference "Attempts to codify guidelines for assessing research quality are invariably detrimental to the practice and application of epidemiological methods." The use of symptoms reporting has been instrumental in the field of occupational epidemiology (Wegman, New Epidemics, Helsinki 1994). While it is true that for issues of causality, prospective studies with hard endpoints are the strongest, it is difficult, for example, to know when osteoarthritis actually begins. Studies of causality (see attachment) are different than those that are trying to estimate reasonable levels of exposure that can be practically assessed (Tables 7-8 in the CES). For the most part, having direct measurement and clinically confirmed endpoints, combined with control of effect modifiers and confounders, are the most desirable studies to have. When these are done prospectively on brand new workers followed over time, they are very strong. However, this does not invalidate other studies. Many of the cross-sectional studies involving physical load suffer from survivor bias or a

healthy worker effect. Observational or direct measurement exposure assessment is available only for those who are still in the workplace. Those who have left work because their musculoskeletal disorder has become too severe to continue working are unavailable for evaluation. This survivor effect is usually most pronounced in the highest exposure categories. The effect of this bias is to underestimate the risk. Thus symptoms reporting is particularly important in these circumstances. Westgaard and Jansen (1992) {Westgaard & Jansen 1992 #5390} compared a questionnaire of symptom intensity and frequency to the probability of medical consultation due to musculoskeletal pain problems. Both are needed in questionnaires to adequately predict who will seek medical treatment. Therefore self-reported symptoms that have intensity and frequency descriptors are good surrogate measures of MSDs particularly when separated from non-work symptoms. Bjorksten (1999) {Bjorksten, Boquist, et al. 1999 #7280} found relatively good sensitivity (95%) and specificity (88%) when comparing symptoms in the last seven days to clinical examination findings for the neck-shoulder area. This is somewhat higher than the results of Ohlsson et al (1994) that reported a sensitivity of 77% and specificity of 78% for the neck shoulder area. The difference may be in the use of visual analogue scales of pain intensity by Bjorksten. Burdorf et al (1998) {Burdorf, Naaktgeboren, et al. 1998 #5950} prospectively followed welders and metal workers and found that symptoms reported the previous year predicted sickness absence quite well for neck/shoulder disorders and upper extremity disorders. In 1996, Burdorf et al {Burdorf, Post, et al. 1996 #27550}, compared self reports of sickness absence due to back pain and respiratory symptoms in the previous six months to sickness absence records. They found high specificity (97%) and sensitivity (88%) for back pain related absence. There was good correlation for duration and frequency of sickness absence due to back pain between self-reports and records ( $\kappa=0.65$  and  $0.61$ ).

There is evidence that workers tend to over-report the duration of exposure to physically stressful factors. In general this would tend to underestimate risk. However, if there is differential reporting of exposure based on symptoms (those with symptoms over-report duration of exposure more than those without symptoms, this would overestimate risk. Viikari-Juntura et al (1996) {Viikari-Juntura, Rauas, et al. 1996 #14060} reported moderate correlation (0.42-0.55) between self-reports and observations of physical workload factors such as frequency of manual handling, duration of trunk flexion, neck rotation, hands above shoulders and squatting or kneeling. The correlations in general were higher for those without LBP than for those with LBP. Jensen et al, 2000, found high correlation between observed and self-reported duration of exposure to knee-straining positions (0.88). Although some have found poor reproducibility in self-reports of physical exposure frequency or duration ({Wiktorin, Hjelm, et al. 1996 #24850}), they have also found no difference in exposure reporting estimates for those who were symptomatic compared to non-symptomatic ({Wiktorin, Vingard, et al. 1999 #28850}). Pope {Pope, Silman, et al. 1998 #7190} compared results from a self-reported questionnaire on physical demands (postures, manual handling, repetitive upper limb movements) to direct simultaneous observations in six different occupational settings. Agreement was quite good for most items ( $> 70\%$ ). Minutes of repetitive arm and wrist movements appeared to be the least accurate (overestimates). These authors concluded that not only is dichotomous recall satisfactory (ever, never) but that exposure magnitude recall is also satisfactory. Toomingas et al, 1997 {Toomingas, Alfredsson, et al. 1997 #31860} tested the hypothesis that those who rate outcomes high on self reports would also rate exposures high on self reports, thereby biasing risk

estimates. Conducting separate analyses by age, gender, socioeconomic status, correlations were close to zero for fixed and non-fixed stimuli, including symptoms and physical exposures, indicating no systematic differences by rating behavior. Consistent findings were reported by {Punnett 1998 #6880} Punnett in comparing self reported physical exposures with observations by researchers blinded to health status in that there was good comparability in estimates. Kerr et al (2000) {Kerr, Frank, et al. 1999 #27850} reported good agreement between back injury cases and job matched controls on self reported physical demands of the job (ICC=0.6) suggesting lack of symptoms related bias in estimates. Bernard et al (1994) compared observational analysis to self-reports of exposure among symptomatic newspaper workers and referents. Both groups reported a longer duration of typing time (around 50% more) than the observational analysis. However, based on both exposure assessment methods, the symptomatic workers had significantly greater exposure to keying time than the referents. The likely effect of the overestimate of exposure duration is an underestimate of risk. Nordstrom et al, (1998) also compared self-reports and expert-observed physical activities at work in the general population for 11 posture and manual material handling factors and found the median difference in mean exposure estimates to be less than ½ hour per day (kappa=0.31). However, there were significant differences in case control status for bending at the waist and twisting of the forearm.

As a whole, these studies support the use of self-reported exposure and disorders in epidemiologic studies although a certain amount of misclassification of exposure and health status may occur. The most likely effect would be to mask true associations, particularly of those with modest magnitude of association. Thus, we disagree with Smith and Karsh's opinion on the use of self-reports.

Additional responses:

Caution zone and hazard zone criteria-see CES for discussion and studies used in making the determination. There have been numerous studies in the literature since the NIOSH literature review (Bernard, 1997). We have taken advantage of that new knowledge in our determinations. The more recent literature strengthens, not weakens, the evidence upon which reasonable determinations can be made regarding caution and hazard zones.

For hand force, we agree that the exertion required rather than the weight of an object handled is a preferable way to evaluate hand force. However, estimates of hand force are often difficult without sophisticated measurement methods. Using weights is a surrogate method. Another method is one of simulation. Wells et al (2000) and Bao (2000) recently reported the use of simulation in estimating grip and pinch force. Consequently, we have included some simulations that can be done to estimate grip force.

With respect to heavy, frequent, awkward lifting, Dr. Smith suggests that these levels are acceptable because they are only hazardous for many, but not most, employees. This reasoning is contrary to basic public health policy and inconsistent with the WISHA Act. The department has, for example, long required fall protection for employees working at height even though *most* such employees may not in fact fall.



“Effective alternative methods” was confusing to Dr. Smith. What is meant by this phrase has been clarified in the rule.

Regarding ergonomics education elements, Dr. Smith suggests the education should be more inclusive of employee opportunities to reduce risk. There is certainly that capacity in the employer’s education program. Nothing in the rule would prohibit this more holistic approach.

Dr. Smith questions the use of the examples of alternative methods to assess hazards. They do not all identify all hazards and some use a more qualitative approach to evaluation and are therefore more subject to bias. The rule does not in fact require any of these approaches, but it provides them as illustrations to assist at least some employers. Dr. Smith does not offer any alternative approaches to assist employers in determining hazards. It is infeasible to expect certified professional ergonomists to cover every workplace. The methods identified as examples have been used in a number of workplaces and provide a basis for the employer to know what kinds of assessment tools are available without limiting the employer to those specific tools.

We would agree that the term “Recovery cycle” is confusing and changed it to recovery time. This could be the period within a cycle that does not include exertion, or rest breaks, etc.

Regarding certifying levels of required training and analysts, the department does not intend to conduct a certification program.

Section 5. Dr. Smith questions the hierarchy of controls. This is a long tradition in health and safety. In fact, the department includes administrative controls along with engineering controls (those not primarily based on worker behaviors), compared to those relying primarily on behavior. The use of seat belts is a good example of when passive restraint systems are preferred rather than active systems. The same approach is applicable in the current situation.

Dr. Smith’s review of technologically feasible control methods is inadequate. The effectiveness of reduced exposures can be viewed in the light of many epidemiological studies where the exposed population was compared to the lesser exposed population in the same workplace or population. The difference in risk is what could be inferred (provided adequate control for confounding factors), from reduced exposure. Additionally, there are numerous case studies in the literature that describe successful control measures. It is true that there are few randomized controlled trials (RCTs) of ergonomic improvements. This is largely because RCTs are more likely to be done with respect to individual behavior. We are unaware of any workplaces that would allow RCTs of engineering controls. The closest such study was by Loisel {Loisel, Abenhaim, et al. 1997 #30100} where low back disability patients were randomly assigned to traditional medical treatment, occupational medicine treatment, ergonomics job improvement and a combination of last two. That study showed that the combined occupational medicine-ergonomics treatment returned workers to work 2.4 times as fast as routine medical care. The majority of that improvement (1.9 times faster) was for ergonomics alone. Quasi-experimental studies are much more likely in the industrial environment. Dr. Smith appears to be confused about the rule’s requirements. Employers have great flexibility in determining what control methods they can implement.

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With respect to Dr. Karsh's review of epidemiological studies, as indicated above, it is mechanical and superficial and was not performed by an epidemiologist. Unlike the NIOSH review by Bernard (1997), this review does not glean what is useful and unbiased about a wide variety of studies in advancing knowledge. A basic occupational epidemiology text, such as Checkoway's, provides helpful guidance in relation to such reviews. For example, the study of Ohlsson et al (1995, 1994) would have been improved had they calculated risks based on quantitative exposure methods or merely assigned the reference group in which there was no repetitive exposure minimal value. Nonetheless, the detailed exposure assessment was performed on the exposed workers and it is reasonable to infer that these exposures are what constitute the risk difference between the groups, given that personal factors were considered in the study. Dr. Karsh uses the same superficial mechanical argument with respect to the studies of Luopajarvi et al (1979). Likewise, the study of Kilbom and Persson (1987) is inappropriately dismissed because the authors report relevant results for the neck/shoulder region and static loading of this area. Karsh mischaracterizes the studies by Silverstein et al (1985, 1986, 1987) with respect to exposure response relationships. In fact there were 3 exposure levels compared to the low-force-low-repetition reference population. Probably the most telling comment is in the criticism of Punnett et al (1991) where the author dismisses the study because Punnett looked at the frequency and duration of non-neutral trunk postures, and describes this as no longer representing quantitative exposure values. One wonders what a similar review would conclude about the epidemiological evidence on tobacco smoke.

In summary, we disagree with many of the premises of Drs. Smith and Karsh in the interpretation of epidemiological studies, but do appreciate their comments, and where appropriate, clarified intent in the rule such as with the description of hand force.

## **Attachment 2: Strong Studies on Causal Association**

This table summarizes a set of studies that provide especially strong evidence for causality. Because temporal relationship is essential for causality, longitudinal studies, preferably prospective, are important. In many of those studies, exposure assessment is based on job title or occupation, especially when the follow-up time has been long. This is because it is not possible to record intensities, frequencies and durations of physical load factors for months or years of exposure time for large populations.

The most convincing studies in the table are those that have utilized the best methodologies in exposure and outcome assessment and analysis.

For prospective studies on back pain, the study by Riihimaki et al. 1994 on sciatic pain is in the table. Other prospective studies are those by Pietri et al. 1992, Stobbe et al. 1988, and Venning et al. 1987.

The study of Kurppa et al. is a prospective study on wrist forearm tendinitis and epicondylitis in the elbow. Incident cases with the disease were those who sought medical care at the company occupational health service. This study has been carried out in Finland, where the medical and social benefits did not differ much depending on whether the case gets reported as an occupational disease or not. Therefore, affected workers are seeking medical treatment more than economic

benefit. It is generally hard to find a reliable and unbiased method to detect incident musculoskeletal disorders, and this study was considered among the best.

As regards disc degeneration and osteoarthritis, there is no perfect way to detect an incident case. Cross-sectional and case-control studies can be carried out. Also, the progress of degenerative findings is telling. The study by Riihimaki et al. with concrete reinforcement workers and house painters on radiographic disc degeneration, and the study by Luoma et al. using magnetic resonance imaging were included in the table as examples, because they were methodologically the strongest. There are several other studies on lumbar (Kellgren and Lawrence 1952, Hult 1954, Hult 1954, Biering-Sorensen 1985) and cervical (Kellgren and Lawrence 1952, Hult 1954) disc degeneration that confirm the findings in these two papers. As these studies are cross-sectional, they are less compelling by themselves than prospective studies. It would be hard to claim that subjects prone to degenerative disorders of the spine would be self-selected to manually strenuous tasks and stay there more than in less strenuous tasks. The association between heavy manual work and disc degeneration in the lumbar spine has been considered convincing (Riihimaki and Viikari-Juntura 2000).

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Table A. Examples of Studies Used in Assessing Causality						
Design	Study population	Outcome	Exposure	Main results	Comments	Reference
Low back studies						
Cross-sectional	216 male concrete reinforcement workers, 201 house painters matched for sex and age, participation rates 84% and 86%, respectively	Disc space narrowing (DSN), spondylophytes (SP), and endplate sclerosis (EPS) in plain lateral lumbar radiographs (Radiographs analyzed jointly by 2 radiologists, blinded for age and occupation; interexaminer repeatability found satisfactory in pilot study)	An average of 14.6 years of exposure to concrete reinforcement and 20.6 years to house painting work (minimum requirement 5 years)	Prevalence of DSN 28% and 15%, of SP 27% and 18% and of ES 11% and 6% in concrete reinforcement workers and house painters, respectively. Crude RR of DSN for concrete reinforcement workers vs. house painters 1.8 (95% CI 1.2-2.7), adjusted RR 1.8 (CI 1.2-2.5), for SP crude RR 1.5 (CI 1.1-2.2), adjusted 1.6 (CI 1.2-2.3). Earlier back accidents associated with DSN in univariate analysis, but did not retain significance in multivariate analysis	Adjustment for age, earlier back accidents, height, BMI, smoking in multivariate analysis. DSN: RR for age 6.5 (CI 1.7-26.0) (50-54 years vs. 25-29 years) SP: RR for age 14.9 (CI 2.3-94.7). DSN occurred at about 10 and SP at about 5 years younger age among concrete reinforcement workers than among house painters	Riihimaki et al. 1990
Cross-sectional	53 machine drivers, 51 construction carpenters, 60 municipal office workers, all males aged 40-45 years (participation rate 71%)	Decreased signal intensity, posterior disc bulges, anterior disc bulges in magnetic resonance imaging (MRI), assessed by 3 radiologists (interrater agreement acceptable, assessments of the most experienced radiologist used in the analysis)	On average 26 years of exposure to whole-body vibration and prolonged sitting (machine drivers), dynamic physical work (construction carpenters), or sedentary work (municipal office workers)	Signal intensity not associated with occupation Posterior bulges most prevalent among carpenters at L3/4 disc (Unadjusted OR2.7 (CI 1.0-7.3)), when adjusted for confounders, no more statistically significant Anterior disc bulges most prevalent in machine operators at each level, remained significant at L4/5 and L5/S1 level in multivariate analysis	Adjustment for history of back accidents in one model, and for height, history of overweight, smoking and physical exercise in another model. (History of back accidents statistically significant for posterior bulges at L3/4 level)  Exposure was assessed both by job title and number of years in different types of work. Results of these analyses similar, and therefore job title used in the analysis	Luoma et al. 1998

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Design	Study population	Outcome	Exposure	Main results	Comments	Reference
Prospective 3 years	1149 men with no sciatic pain at the onset of the study (387 machine operators, 336 carpenters, 426 office workers), mean age 37-38 years, response rate to questionnaire 79-89%	Incident sciatic pain (low-back pain radiating to a leg) by questionnaire at the end of 3-year follow-up	On average 13.3 years of exposure to whole-body vibration and prolonged sitting (machine drivers), 15.5 years to dynamic physical work (construction carpenters), and 9.0 years sedentary work (municipal office workers)	3-year cumulative incidence of sciatic pain 22% for machine operators, 24% for carpenters and 14% for office workers Crude RR 1.6 (CI 1.2-2.2) for machine operators vs. office workers and 1.7 (CI 1.3-2.4) for carpenters vs. office workers, adjusted RR 1.4 (CI 1.0-1.9) and 1.5 (CI 1.1-2.1), respectively (History of other type of low-back pain the strongest predictor, RR for mild pain 2.7 (CI 1.7-4.2) and for severe pain 4.5 (CI 2.7-7.6))	Health-based selection of workers at baseline, i.e. that only the most resistant subjects to back pain in the occupations with high risk will remain healthy, is likely to dilute the RRs between machine operators and office-workers and carpenters and office workers.	Riihimäki et al. 1994
Shoulder studies						
Cross-sectional	54 bricklayers, 55 rock blasters, 98 foremen, all men, participation rate 72, 73 and 89%, average age 50, 51, and 46 years, average years in occupation 28, 23, and 20 years	Acromioclavicular joint arthrosis on plain radiography, assessment by radiologist and orthopedic surgeon blinded to age and occupation	Job title, sum of load lifted during working years, years of manual work, sum of hours of exposure to vibration	Prevalence of osteoarthritis (grade 2-3) 59.3 and 40.7%, 61.8 and 56.4%, and 36.7 and 23.4% in the right and left side in the bricklayers, rock blasters, and foremen, respectively. ORs for bricklayers vs. foremen 2.2 (CI 1.1-4.1) and 1.8 (CI 0.8-3.9), and for rock blasters vs. foremen 2.1 (CI 1.0-4.6) and 4.0 (1.8-9.2). Dose-response relationship for years of manual work, lifted load, and vibration (ORs standardized for age)	A healthy worker effect is likely to dilute the results of this study	Stenlund et al. 1992
Cross-sectional	As above	"Clinical entity of shoulder tendinitis" (pain in the shoulder last year + either pronounced pain on palpation of the muscle	As above	Prevalence of clinical entity of shoulder tendinitis 1.8-1.8%, 14.5-23.6%, and 3.1-9.2% among the three occupational groups. For clinical entity of shoulder tendinitis, only vibration exposure statistically significant, for signs of shoulder tendinitis OR for highest vs. lowest	Vibration seems to be a risk factor for shoulder tendinitis, the results being only borderline significant. Years of manual work and the sum of lifted load did not seem to be risk factors for shoulder tendinitis.	Stenlund et al. 1993

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Design	Study population	Outcome	Exposure	Main results	Comments	Reference
		attachment or pain in isometric contraction, any of the four rotator cuff muscles). Analysis done also for signs of shoulder tendinitis		category of vibration 2.4 (CI 0.9-6.3) on the right and 3.0 (CI 1.0-9.4) on the left side	The outcome, accepting palpation pain as objective finding, is not very strong	
Case-control	79 cases and 124 referents (all except 4 were men) in the automobile assembly	Shoulder disorder (reported to the plant medical department and having had shoulder pain on more than 3 occasions or for more than 1 week the last year)	One typical work cycle was recorded on video for all study subjects. Shoulder posture was analyzed (neutral, mild flexion, severe flexion, total duration, percentage and frequency per cycle, right and left side separately). Peak reactive shoulder torques analyzed with a 3-dimensional biomechanical model	OR for severe (>90°) abduction/flexion 2.9 (CI 1.6-5.4) and 1.9 (CI 1.1-3.4) for all cases, and 3.2 (CI 1.5-6.5) and 2.3 (CI 1.2-4.8) for cases with physical examination findings (the two numbers are for exposures on right and left side, disorders on the right and left side were combined) Dose-response relationship for per cent of cycle time in severe shoulder flexion (none, <10%, ≥10% of cycle time)	The strength of the study is the objective exposure assessment and clinical assessment for both cases and referents. The higher ORs from the analyses using only clinically confirmed cases speaks for an association between the physical load factors and true disease. A drawback was that clinical examination was carried out on average 28 days after the case reported the disease to the plant medical department	Punnett 2000
Elbow disorders						
Prospective 2.6 years	102 male meatcutters (248 person years (py)), 107 female sausage makers (220 py), 118 female	Lateral or medial epicondylitis (tenderness to palpation at epicondyle, and pain in resisted extension/flexion	Meat cutting, sausage making and packing are all highly repetitive jobs, meatcutting involving	Incidence density of epicondylitis 6.4, 11.3, and 7.0 per 100 person years for the meatcutters, sausage makers, and packers, respectively, and 0.9 and 1.1. for the men and women in non-strenuous jobs	Incidence rates in meatcutters, sausage makers, and packers not directly comparable to those in non-strenuous tasks, because the physical demands of the job	Kurppa et al. 1991

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	packers (253 py) and 141 men (334 py) and 197 women (456 py) in nonstrenuous tasks	of the wrist) verified for workers seeking medical advice because of elbow pain	continuously and sausage making in some tasks high hand forces. The tasks of the packers mostly did not involve high forces. Packers were also exposed to cold work environment (8 to 10° C)		determine how much disability is caused by epicondylitis, and who will seek medical advice. Therefore, any incidence rate ratio is likely to be an overestimate of true risk. It is unlikely, however, that all differences between strenuous and non-strenuous tasks would be due to only seeking medical advice.	
Wrist disorders						
Prospective 2.6 years	As above	Tenosynovitis or peritendinitis for the wrist or forearm region (swelling or crepitation and tenderness to palpation along the tendon and pain at the tendon sheath, in the peritendinous area, or at the muscle-tendon junction during active movement of the tendon)	As above	Incidence density of tenosynovitis/peritendinitis 12.5, 16.8, and 25.3 per 100 person years for the meatcutters, sausage makers, and packers, respectively, and 0.9 and 0.7 for the men and women in non-strenuous jobs	As above	Kurppa et al. 1991
Cross-sectional	652 industrial workers	CTS, definition by symptoms and symptoms + signs	39 jobs allocated to 4 exposure categories (LOF-LOR, LOF-HIR, HIF-LOR, HIF-HIR) by walk-	Adjusted ORs for HIF-LOR, LOF-HIR and HIF-HIR vs LOF-LOR 1.8, 2.7 and 15.5, respectively (adjusted for age, gender, plant, and years on job)	The strength of the study is in the objective assessment of exposure and good contrasts between the different exposure groups. Outcome assessment by	Silverstein et al. 1987

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Design	Study population	Outcome	Exposure	Main results	Comments	Reference
			through (video-recordings and emg measurements for 3 workers per job)		clinical examination	
Cross-sectional	As above	CTDs (mainly tendon disorders) by clinical examination	As above	Adjusted ORs for HIF-LOR, LOF-HIR and HIF-HIR vs LOF-LOR 5.2, 3.3 and 29.1, respectively (adjusted for age, gender, plant, and years on job)	As above	Silverstein et al. 1986
Cross-sectional	352 workers in 39 jobs with a minimum of 6 months seniority in their job.	CTS by hand diagram, NCV, and hand-diagram + NCV	Repetition, force and posture assessed by observation, subjects allocated into 3 groups according to repetition	Prevalence of CTS based on hand diagram 6.8%, 14.5%, and 17.4% in the low, medium, and high repetition categories, respectively. Median mononeuropathy not related to the level of repetition. Prevalence of CTS based on hand diagram and median mononeuropathy 2.7%, 4.9%, and 7.9 (p=0.06)	The strength of this study is the selection of study groups to encompass jobs with varying levels of repetition. Both exposure and outcome with objective assessment	Latko et al. 1999



## **Response to Comments by Associated General Contractors of Washington And Inland Northwest Associated General Contractors**

The department has analyzed and responded fully to the comments by the AGC of Washington and by the Inland Northwest AGC. The department response may be found in three places: this response summary to both construction employer associations, the CES narrative and Appendix D to the CES.

1. *Slips, trips, falls and motor vehicle injuries have been exempted from this proposal, but the statistics used to justify this standard still contain these injuries. (AGC of WA)*

The comment is in error. Data based on slips, trips, falls and motor vehicle injuries were excluded from the analysis on which the rule was based after this issue was raised during the rule development conferences in late 1998. The data is discussed more extensively in the CES.

2. *The consensus is that terms such as degree feasible, typical work, sufficient degree of risk and reasonable determination are very subjective terms . . . (Inland Empire AGC)*

“Typical work” has been clarified in the final rule and is discussed further in the CES narrative. “Reasonable determination” does not require action by the employer but rather anticipates department acceptance of the employer’s determination. The courts have long relied upon tests such as the “reasonable person” test in interpreting and applying both criminal and civil laws. “Sufficient degree of risk” apparently refers to the definition of hazard in the general performance approach. While the department has concluded that the definition is adequate (particularly when balanced against the need to provide flexibility), employers who wish greater clarity can choose the specific performance approach.

Problems with wording, such as:

*“must be reduced” should be changed to reflect that attempts have been made, even though the job may still and always be a “caution zone job.” (AGC of WA)*

*“...the Department wants to reduce workplace hazards or reduce workplace hazards to the degree possible. Both of these concepts are immeasurable and vague.” (Inland Empire AGC)*

The rule creates no obligation to eliminate caution zone jobs – employers with such jobs must provide ergonomics awareness education and must analyze the jobs (using either the general or specific performance options) to determine whether the exposures are in fact hazardous. For those jobs where the risk factors represent *hazards* (as opposed to those jobs that are in the caution zone but are not determined to be hazardous), the rule requires employers to reduce them until they are no longer hazards as defined by the criteria or to the degree feasible (WAC 296-62-05130(4)).

While it may be true that many jobs will remain “caution zone jobs,” that is not an issue. For *hazardous* exposures, however, an employer’s failed attempt to address the hazard is not sufficient in relation to these risk factors any more than it would be in relation to any other

hazard. If it is feasible to correct the hazard, the employer must do so, even if he or she has tried previously and has failed.

“Degree of Feasibility” will lead to long, expensive court cases in which no one wins. We recommend using “consistent with industry best practices.” (AGC of WA)

Feasibility is a well-established concept within occupational health and safety law. It is used in other standards (such as the fall protection requirements for scaffold erection/dismantling and the respiratory protection requirements for effective engineering controls). It is also described in case law related to agency burdens in rulemaking and enforcement. We do not think there will be “expensive court cases” regarding the meaning of “feasibility” because the federal courts have already resolved similar issues under the OSH Act. Further, the CES narrative discusses the issue of feasibility in relation to the ergonomics rule.

It is unclear that the use of “consistent with industry best practices” as a requirement of compliance would provide any greater clarity, and it certainly has not been subjected to legal tests already. Some comments also were received discouraging the department from relying on best practices, although the final rule still provides for discussions with industry labor and management to more clearly define feasibility by the use of accepted practices where that is possible. The department already has such an initiative in place with representatives of the roofing industry and is involved with ongoing discussions related to wallboard. We expect to launch a similar effort in relation to masonry within the next two months.

3. *The implementation timeframe is not attainable without additional measures for construction.... Contractors have less than 15 months to perform their analysis and begin the education process. (AGC of WA)*

Ergonomics awareness education is *not* dependent on the employer’s hazard analysis, and the final rule has made the portability of such education more clear. However, the department extended the time frame so that all employers will have additional time. Large construction contractors in the listed SIC codes (which do not cover all of construction) will have two full years (until July 1, 2002) before being required to provide ergonomics awareness education and complete the hazard analysis. Other contractors will have as much as five years (until July 1, 2005) to complete these initial steps.

4. *In construction, Labor and Industries has not been consistent in their enforcement attempts regarding the multi-employer liability (Stute decision, WRD 93-4 and 27.00). With this current trend contractors have no reason to believe in and/or trust Labor and Industries. AGC members will be greatly impacted by the differences in the implementation periods for the varied size companies affected by the regulation. (AGC of WA)*

L&I has engaged in ongoing discussions with the AGC about enforcement under *Stute*. The Construction Advisory Committee has commissioned a subcommittee to work on the issue, and it will begin its meetings in June. In relation to the specific issue of the application of *Stute* to ergonomics, the department has agreed that no general or upper-tier contractor will be held

accountable for the exposure of a subcontractor's employees to WMSD hazards until the rule is fully in effect for all employers (July 1, 2006).

5. *The cost to the construction industry has not been thoroughly analyzed by Labor and Industries. . . . (AGC of WA)*  
*An independent cost benefit analysis, which should have been accomplished by now, has not been accomplished . . . . (Inland Empire AGC)*

The complete Cost Benefit Analysis, required before the final rule could be adopted, includes an analysis of the costs to construction as well as to other industries. The department determined that it was able to do the required analysis internally, and the analysis is available for review. In the case of construction, the analysis concluded that the benefit to cost ratio is 4.25. The Cost Benefit Analysis is discussed more extensively in the CES narrative.

6. *Training and education are the cornerstone. Labor and Industries is proposing this rule before the existence of industry solutions. (AGC of WA)*  
*The Department is going to provide help for employers to implement the rule. After the rule has been implemented, the Department will develop compliance guidance, identify industry best practices, establish inspection policies and procedures, test the guidelines and collect and share information. . . . It is clear that the Department should have already completed these activities. (Inland Empire AGC)*

Solutions are already available in construction, as described in the CES narrative and documented in the rulemaking file. In addition, the extended phase-in period provides additional time to refine existing solutions and to develop new ones.

The department has determined that this implementation schedule provides sufficient time for the department and industry groups to complete the necessary tasks. L&I will, however, review the experience of the demonstration projects with the WISHA Advisory Committee and the Construction Advisory Committee. Based on the experience in those projects, L&I will provide additional guidance regarding acceptable practices, safe harbors and compliance. L&I also will consider the need for possible revisions of the rule

7. *The expansion of regulations imposed on employers does not assure WMSD injury reduction. (AGC of WA)*  
*At this point, there is no guarantee that this proposal will either reduce or eliminate WMSDs. (Inland Empire AGC)*

The department has concluded that employer compliance with the specific requirements of the ergonomics rule will result in a substantial reduction in WMSDs. The basis for this conclusion is discussed more fully in the CES narrative and documented in the rulemaking file.

8. *The information presented [in the published economic summary and the SBEIS] was primarily based on data collected from only two surveys of a cross section of Washington employers. The total number of respondents appeared to be inadequate . . . information*

*and data extrapolation was extreme . . . there has been an excessive use of estimates and assumptions to establish economic facts. (Inland Empire AGC)*

The cost-benefit analysis (CBA) was done with the best available evidence and used standard economic methods. The surveys on which it was based represented a statistically valid sample. The assumptions in the analysis are normal (no such analysis can be completed without assumptions and estimates). In most cases the department chose conservative assumptions. The analysis was completed in accordance with accepted principles of accounting and cost analysis.

9. . . . *if historical claims data collection is a valid means of proving a need for this rule and its immediate implementation, logic and reason should dictate that historical claims data would also be a valid means of proving the lack of a need to comply with this rule. (Inland Empire AGC).*

The assumption made in the comment, while understandable, is incorrect. Just as it would be an error to assume that a person who had never had a motor vehicle accident had no need for auto insurance – or even seatbelts – it is a mistake to assume that statistical analyses that are valid on a large scale are valid on a small scale. Similarly, a roofer whose employees have never fallen from a roof cannot necessarily assume that his or her fall protection is adequate based on that experience alone. In relation to WMSDs, this is particularly true in construction where the transient workforce means that an employee who is exposed to a risk factor (and experiences cumulative stress) working for several employers will only have an industrial insurance claim charged against one of them. The basis for the requirements in the rule is discussed in further detail in the CES narrative.

10. . . . *We do not dispute the fact that employee input into problem solving is very valuable. However, the final decision and subsequent selection of procedures or equipment is clearly a management decision. (Inland Empire AGC)*

The department agrees, at least to the extent that the management decision is in compliance with applicable laws and rules. Nothing in the rule changes that relationship – in fact, the employee involvement required is consistent with that required in the safety committee/safety meeting requirements found in existing WISHA standards.

11. . . . *Federal OSHA has elected to not include construction as an affected industry under their proposed rule. OSHA's intent is to write a separate rule that will apply to or be more conducive to the construction environment. Apparently OSHA's management is of the opinion that different industries will require different guidelines and that one rule cannot be effectively applied to all industries. National AGC has endorsed this OSHA policy. (Inland Empire AGC)*

The proposed federal rule uses an injury trigger. The state rule uses a hazard-based approach for reasons discussed previously and described in further detail in the CES. It would be a mistake to assume that because OSHA does not intend to apply their current proposal to construction then they have concluded that no rule can be developed that applies to construction as well as general industry. It also would be a mistake to assume that OSHA believes all industries need their own

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standards, since their proposal clearly applies to a range of general industries (manufacturing, service, etc.). In any case, the WISHA rule relies upon the identification and elimination of specific hazards that generate risk whenever they are present and that the department has concluded can be controlled in construction, as well as in other industries.

12. . . . *another question must be asked, which is why must we immediately implement a rule which may be deemed as not being as effective as the federal rule? How much time, money, and effort might be wasted? (Inland Empire AGC)*

In the case of construction, there is no proposed federal rule and OSHA will permit a validly promulgated state rule to stand. So, while comparisons of the two rules are premature in most contexts, construction employers can remain confident that the WISHA rule will not be found less effective in relation to their work.

13. . . . *A pilot program, which would include a genuine cross section of Washington businesses, should provide accurate data that would eliminate the need for extensive estimates and assumptions. (Inland Empire AGC)*

The department considered and rejected the need for a pilot program because ample information is already available on which to base the rule and the required analyses. This is discussed in more detail in the CES narrative and CES Appendix E.

### **Response to Comments by Washington State Farm Bureau: Summary**

The department has analyzed and responded fully to the comments by Washington State Farm Bureau. The Washington State Farm Bureau comments are very similar in content to those submitted by the Association of Washington Business (AWB) and Washington Employers Concerned About Regulating Ergonomics (WE CARE) except they are briefer and include several specific additional comments concerning agriculture. The department response may be found in four places: this summary, the CES narrative and Appendix D to the CES, the department's cost-benefit analysis and the department's response to AWB/WE CARE and the attachments to that response. This summary addresses only the agriculture specific comments.

1. *Despite being labor intensive, agriculture ranks low in WMSDs. How did the department factor in this contradiction? We must conclude that other non-work related factors must significantly contribute to WMSDs.*

Except for landscape and horticultural services, agricultural workplaces are not among those with the highest rates and numbers of WMSDs and therefore are not in the first group covered by the rule. However, there are substantial numbers and rates of WMSDs in agriculture and the rule will appropriately help to reduce these. For example, from 1990-1998 the annual average rate of WMSDs among state fund employers in SIC 029 (general farms) was 38 per 1000 FTEs. The rate was 19 per 1000 FTEs for SIC 017 (fruits and tree nuts), 28 per 1000 FTEs for SIC 011 (cash grains), 41 per 1000 FTEs for SIC 018 (horticultural specialties) and 48 per 1000 FTEs for SIC 025 (poultry and eggs).

The rule only covers those employers with jobs that are in the caution zone and only requires that jobs with hazards be fixed. The rule appropriately covers all workplaces with hazards, even those in industries that overall are less hazardous. Jobs that are "labor intensive" do not necessarily include WMSD hazards or risk factors for WMSDs.

The department agrees that non-work factors contribute to musculoskeletal disorders, but the rule only requires employers to address risks and hazards that are present at work.

The department believes that there is underreporting of workplace injuries and illnesses in agriculture beyond that which may exist in other industries, related to the seasonal and migrant nature of the workforce.

2. *Are employers required to time the duration of each hand movement used in picking or the period over which many hand movements are taken?*

The final rule clarifies that duration refers to the total amount of time per day employees are exposed to the risk factor, not how long they spend performing the work activity that includes the risk factor. The employer must make reasonable determinations. The CES explains that the department does not expect employers to analyze every movement of each worker for the full length of each day. Reasonable methods of representative sampling will be acceptable for determining whether there are caution zone jobs and whether there are

hazardous jobs. The rule does not require special expertise or expensive equipment to make these determinations.

3. *Unlike other industries, agriculture has very few options to comply. In most cases there is only one way to pick a fruit or vegetable. The only viable option for agricultural employers is to significantly increase the size of their workforces to reduce employee's individual exposure.*

The final rule states clearly that employers are required to reduce exposures below hazardous levels or to the degree it is economically and technologically feasible to do so. The rule thus anticipates and allows for circumstances in which an industry may have few feasible options.

The final rule also states that employers are not required to replace full time with part time employees or otherwise reduce an individual's hours of employment to be in compliance.

4. *We estimated that the proposed rule might cost the industry approximately \$190 million annually, based on an anticipated workforce expansion of 25%.*

L&I believes that the premise of a required 25% expansion of the agricultural workplace is incorrect. Nothing in the rule would lead to this outcome. The department's cost-benefit analysis projects a total cost of \$4.7 million annually for agriculture and forestry combined. It also projects a benefit-cost ratio of 1.55 for agriculture and forestry combined.

5. *How would agricultural employees be involved in participation where there are monthly foreman-crew meetings and no safety committees?*

The rule requires that employers provide for and encourage employee involvement but does not specify how an employer must do this.

6. *Tree fruit growers have experienced problems when the state fails to coordinate rulemaking with OSHA. Two months prior to cherry harvest last year OSHA notified the department that its rules were not "at least as effective as" OSHA's.*

The comments state that OSHA found L&I's cherry harvest rules to be not as effective as the federal temporary worker housing rules. This is not true. In 1999 OSHA did find that rules adopted by the Department of Health were not as effective as OSHA's. The DOH rules were less stringent than the WISHA rules at the time, which had previously been declared "at least as effective as" OSHA's. L&I and the Washington State Department of Health this year adopted new temporary worker housing rules, including rules for the cherry harvest. OSHA has publicly expressed satisfaction that these new rules are as effective as OSHA's own rules. In any case, there is no federal standard specific to WMSDs, so the relative effectiveness of the WISHA rule is not currently issue.

7. *The agricultural industry wants written assurance that OSHA will not require a rewrite of the department's rule.*

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It is not plausible that OSHA will provide a written assurance of this type before either a state rule or federal rule is in place. L&I does not believe it would be appropriate to request such assurance from OSHA and will not make such a request.

8. *OSHA believes that agriculture and construction have unique characteristics that warrant separate rulemakings.*

OSHA's proposed ergonomics rule is injury-based. An injury-triggered rule may not work well for industries like agriculture and construction that have transient, seasonal, migrant or job based workforces. However, the WISHA rule was designed with several features that were intended to make it applicable to a wide variety of industries, including agriculture and construction. For example, the rule is hazard-based, education requirements are portable, and employers are provided substantial performance choices. This is more fully discussed in the CES narrative and CES Appendix D.

9. *Multi-state agricultural employers may have to comply with more than one set of ergonomics regulations.*

Since there is no federal OSHA standard at this time, the concern is premature. However, the U.S. Congress and the Washington State Legislature provided the State the authority to promulgate safety and health rules different from federal rules with knowledge that this might subject multi-state employers with more than one set of requirements. L&I believes that Congress and the Legislature made this decision with the belief that the advantages of such a system outweighed the disadvantages. In practice, where there are different federal and state rules (such as the rules for fall protection in construction) this has not proven to be a serious problem for employers.



### **Responses to Comments by The Pacific Maritime Association (PMA) and Jones Stevedoring Company: Summary**

The department has analyzed and responded fully to the comments by PMA and Jones Stevedoring Company. These two comments were very similar and are considered together here. The CES narrative, Part 1 of this Appendix, and the department's cost-benefit analysis also contain responses to many of the issues raised by these comments.

1. *Caution Zone Job determinations are made without reference to the overall workplace exposure and recovery times. For our industry, the job mix and the days not worked due to limited job opportunities, provides recovery periods that need to be considered.*

Typical work activities that are "regular and foreseeable" are further clarified in the final rule to be those that occur on more than one day per week, and more frequently than one week per year. The final rule also clarifies that duration of the specific risk factors refers to the total amount of time per day employees are exposed to the risk factor, not how long they spend performing the work activity that includes the risk factor.

In addition, the department has considered the issue of recovery periods and has concluded that the risk factors described in the rule provide sufficient guidance regarding those issues. The caution zone determination and the specific guidance in Appendix B were both based on appropriate cumulative exposures to particular risk factors during the work day. For the purposes of clarity and ease of use, this guidance does not distinguish between cumulative exposures that result from a continuous activity and cumulative exposures that result from intermittent activity. However, it is an error to presume that intermittent activity necessarily reduces the risk. The exposure levels in the rule are based on the best available evidence and can appropriately be applied in a range of industries and activities.

2. *Our jobs and working conditions are often defined by others. This may result in a situation where the employer may not be able to implement fixes even where they may be technically feasible.*

Where hazards are identified, the rule only requires employers to do what is technologically and economically feasible to reduce those hazards below the hazardous level. The feasibility considerations built into the rule allow for circumstances where the employer cannot implement feasible controls due to constraints beyond their control. The CES narrative addresses this in more detail.

3. *The department's claim that 32% of all injuries are due to ergonomics is not supported by our data.*

Over a third of all accepted workers' compensation claims from State Fund and Self- Insured employers in Washington State (1990-1997) were from work-related, non-traumatic soft-tissue musculoskeletal disorders. The maritime industry has a significant number of WMSDs.

For example, data from the U.S. Bureau of Labor Statistics shows that the rate of total overexertion injuries, including overexertion in lifting, in SIC 4490 (which includes marine cargo handling) was nearly double the rate for all industries in 1997. In the State of Washington the rate of total overexertion cases for SIC 44 was more than double that for all industries in 1997. The injury and illness data on which the rule is based is discussed more extensively in the CES narrative and supporting documents.

4. *Washington needs to be sensitive to the highly competitive global international shipping business.*

L&I has completed a full cost-benefit analysis of the rule. Statewide, the estimated benefits from the rule are more than 4 times the estimated costs. Furthermore, although the benefit-cost ratio varies by major industry, estimated benefits exceed estimated costs in all of them. This is discussed fully in the department's cost-benefit analysis. The CES narrative discusses economic feasibility in more detail.

5. *The cost summary included with the proposed rule does not in any way reflect the PMA estimated costs to support this rule. Additional manning required under the rule as currently written could cost the industry \$54,000,000 in additional annual labor costs.*

L&I believes that the assumptions and cost estimations provided by the maritime industry relating to caution zone job evaluations, hazard analysis, and training are incorrect. The employer must only make reasonable determinations to identify caution zone jobs. The rule does not require special expertise or expensive equipment to make these determinations. The CES explains that the department does not expect employers to analyze every movement of each worker for the full length of each day. Reasonable methods of representative sampling will be acceptable for determining whether there are caution zone jobs and hazardous jobs. An illustrated checklist is provided in Appendix B to facilitate hazard analysis for those employers who choose to use the specific performance approach. In addition, the department will be working with industries during the long phase-in period to identify industry best practices that could be used as "safe harbors" when enforcement begins.

The ergonomics awareness education requirements are general in nature, so that they will be "portable" and can be applicable to employees who may perform in a number of different types of jobs. The department expects that general awareness training will be widely available from a number of different sources, including materials the department will provide as an option for employers to meet the requirements. Specific training required in the rule is limited to those situations where measures to reduce WMSD hazards include changes to the job or work practices.

In regards to potential costs associated with increased "manning," the final rule clarifies that employers are not required to replace full-time employees with part-time employees or otherwise reduce an individual's hours of employment to be in compliance.

6. *OSHA believes the maritime industry has unique characteristics that warrants separate rulemaking.*

OSHA's proposed ergonomics rule is based on and triggered by the occurrence of injuries, which may make it more difficult to apply to transient workforces. However, the WISHA rule uses a hazard-based approach and was designed with several features that were intended to make it applicable to a wide variety of industries, including maritime. For example, employers are held accountable only for defined and measurable hazards that may be present in their workplace, education requirements are portable, and employers are provided substantial performance choices. This is more fully discussed in the CES narrative and Part 1 of this Appendix.

7. *Training on the ergonomic principles should be general rather than having to tailor them for each specific job or industry.*

With regard to the awareness education requirement, the department agrees. The final rule language on awareness education requirements was changed to ensure that this education would be truly general and "portable." The education is not tied to specific characteristics of the type of job an employee is assigned. In relation to the implementation of appropriate control measures, however, any necessary training must of course be appropriate to the control measures and the context in which they are applied.

8. *Providing the training on ergonomic principles within 30 calendar days will be nearly impossible for that portion of our workforce that is obtained from the state unemployment office. The 30 calendar days should be changed to 30 working days.*

The department expects the general ergonomics awareness training to be widely available and in many cases provided by unions, apprenticeship programs, temporary employment agencies, community colleges and others. In addition, L&I will develop ergonomics awareness education materials that will be available for employers to meet the education requirements. Thirty calendar days should not be unreasonable to meet the relatively modest general awareness education requirements. The department concluded that changing it to 30 working days would provide insufficient protection to workers who move between employers.

9. *The requirements of the basic awareness education will mean each employer will need to hire an ergonomics consultant to provide specifics on each point.*

As noted above, the basic awareness education requirements in the final rule are very general in nature so that the education is fully "portable" from job to job and industry to industry. Awareness education materials will be available through the department. Ergonomics consultants will not have to be hired to meet the awareness education requirements, though the rule does not prohibit an employer from doing so if they choose.

10. *The nature of our work changes for every vessel that comes into port. There has to be flexibility in the application of these standards or predetermined "safe harbor" provisions to enable work to continue if unexpected conditions are encountered.*

The rule only applies to typical work activities that are a "regular and foreseeable" part of the job. The final rule further clarifies typical work activities that are regular and foreseeable as those that occur on more than one day per week and more frequently than one week per year. In addition, the rule only requires employers to reduce hazards that are identified to the degree technologically and economically feasible. The department will be working with industries on voluntary efforts throughout the lengthy phase-in period, and these efforts include the identification and sharing of industry best practices that could be used as "safe harbors" once enforcement of the rule begins.

11. *The employee involvement requirements of the rule should be limited to only a review of actual accidents.*

The department does not agree. This is a hazard or prevention-based rule, and injuries do not trigger any of the requirements. The rule requires employee involvement in analyzing caution zone jobs and selecting measures to reduce them, but leaves flexibility for how this is accomplished.

12. *If the neck and back bending angles in Appendix B were applied to office workers, we would probably have no office workers.*

Appendix B in the final rule was clarified so that the neck and back bending risk factors are noted to be "without support or the ability to vary posture." This change means the rule would not address situations where employees voluntarily assumed awkward postures (for example, reading a book with the neck bent) and could easily change them.

13. *The grip and angle requirements of Appendix B applied to a steering wheel for drivers are not clear.*

This risk factor in Appendix B was also clarified by noting that it applies to "gripping an unsupported object(s) weighing 10 or more pounds per hand or gripping with a force of 10 pounds or more per hand." This change means the rule would not address situations where the grip force was applied to a supported object (for example, a truck steering wheel) and this force did not equal 10 or more pounds per hand (comparable to clamping light duty automotive jumper cables onto a battery) for more than 2 hours total per day.

14. *The vibration requirements in Appendix B should be clarified so as not to include whole body vibration.*

The specific risk factors in the proposal related to tools. However, the department agrees that the rule could state this more clearly. For this reason reference to this risk factor throughout the rule was changed to "hand-arm" vibration to distinguish it from whole body vibration, which is not addressed by the rule (although it does represent a documented risk factor).

### **Response to Comments by The National Federation of Independent Business: Summary**

The department has analyzed and responded fully to the comments by the National Federation of Independent Business. The department response can be found in this summary, the CES narrative, Part 1 of this Appendix, and in the department's Cost-Benefit Analysis.

1. *Early assessments from our members indicate that the time they would need to comply would be significantly greater than the time mentioned in the SBEIS. Identifying caution zone jobs and then identifying hazards would be very time consuming and this would mean considerable costs on small business.*

The completed Cost-Benefit Analysis contains a list of the time estimates used to calculate costs of the various requirements in the rule. A number of the time estimates used in the SBEIS were lengthened for the Cost-Benefit Analysis (CBA) after considering comments received, and are in fact greater than the actual time anticipated by the department. The final CBA estimated annual costs for statewide compliance at \$80.4 million, however the estimated annual benefits statewide was \$340.7 million. This is a benefit-cost ratio of 4.24. The CBA was based on the best available evidence and shows clearly that the benefits of the rule exceed the costs of compliance.

2. *Language in the rule is ambiguous. This will lead to confusion for most small businesses. Most small business owners we talked with felt they could not be in compliance no matter which direction they chose to go.*

Although the proposal's Appendix B provided specific compliance levels for employers choosing the specific performance approach, the final rule provides a number of additional clarifications based on comments received. For example, the final rule states explicitly that employers are not required to replace full-time employees with part-time employees or otherwise reduce an individual's hours of employment to be in compliance. The rule contains specific definitions for caution zone jobs and hazards. When identified hazards are reduced below the hazardous level the employer is in compliance and no further action to address those hazards is required. Employers will also be able to take advantage of the very long phase-in period (4-5 years for most small employers) before enforcement begins to educate themselves about the rule and seek answers to any questions they may have.

3. *L&I should not proceed with this rule in light of OSHA's proposed rule. Our members are concerned about the confusion that could arise with two very different rules.*

The OSHA proposal does not affect rule making in Washington State because federal law allows states with approved state plans to adopt their own occupational safety and health rules. Employers, especially small employers, should not be confused because employers in Washington will have to comply with only the state safety and health rules, not the federal rules. Although the Washington state ergonomics rule would need to be judged "at least as effective as" any federal OSHA rule that may eventually be adopted, the rules do not have to be the same.

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4. *L&I should withdraw the proposed rule and instead embark on pilot projects geared toward gaining more knowledge regarding the structure and make-up of small business.*

The department considered and rejected the need for a pilot program because ample information is already available on which to base the rule and required analyses. More detail on this issue is provided in Appendix E of the CES and the CES narrative.

### **Response to Comments by The Independent Business Association: Summary**

The department has analyzed and responded fully to the comments by the Independent Business Association. The department response may be found in this summary as well as the CES narrative, the CES Appendix D, Part 1, and the cost-benefit analysis.

1. *The proposed rules establish "caution zone" and hazard limits that are one-size-fits-all. These limits apply equally to 20-year old men and 65-year old women. The rules must be completely re-written to appropriately address this fundamental fact.*

As discussed in the CES narrative, the department has concluded that it would not be appropriate to adopt a rule that invites employers to distinguish between employees based on age and gender, among other factors. The rule does not establish "limits" in the caution zone, which simply prompts the need for awareness education and further review. For employers who choose to rely upon the specific performance approach, the guidance in Appendix B is based on a sound scientific analysis of the risk involved as it applies to the general population. It would be an error to assume that 20-year-old males exposed to the hazards described in Appendix B are not at meaningful risk of injury due to those exposures. The basis for the hazard levels in Appendix B are discussed more fully in the CES narrative.

2. *There is no definition of "to the extent feasible". It is unfair for the department to adopt a rule that is so indecisive on whether an employer is or is not in compliance. The proposed rule will create a huge number of disputes over whether the requirements of the rule have been met or not.*

Feasibility is a well-established concept within occupational health and safety law. It is used in other standards (such as the fall protection requirements for scaffold erection/dismantling and the respiratory protection requirements for effective engineering controls). It is also described in case law related to agency burdens in rulemaking and enforcement actions. The federal courts have defined "feasibility" under the OSH Act, and we believe Washington courts will follow the federal precedents. The CES narrative discusses the issue of feasibility in relation to the ergonomics rule.

3. *The proposed WAC 296-62-5160 (Help for employers in implementing the rule) need to be completed before the rule is adopted, not after. This is a clear demonstration this rule is not yet complete nor ready for adoption.*

Sufficient knowledge about solutions is already available, as described in the CES narrative and documented in the rulemaking file. In addition, the extended phase-in period provides additional time to refine existing solutions and to develop new ones.

The department has determined that this implementation schedule provides sufficient time for the department and industry groups to complete the necessary tasks. L&I will, however, review the experience of the demonstration projects with the WISHA Advisory Committee. Based on the experience in those projects, L&I will provide additional guidance regarding acceptable

practices, safe harbors and compliance. L&I also will consider the need for possible revisions of the rule

4. *The department's SBEIS projects a cost of \$17.90 for a firm with 10 employees to read and understand how to implement the rule. The \$17.90 would represent a total of 21 minutes for a small business owner to read and comprehend the rule. This clearly is an inadequate estimate and fails to meet the requirements of the state's Regulatory Fairness Act.*

The cost estimates in the SBEIS and in the completed Cost-Benefit Analysis are presented as an average cost “per employee,” not “per affected employee.” The estimates are sound and are described in more detail in the complete CBA. The cost-benefit analysis estimated two hours for small employers to read and understand the rule. The cost for this is presented as an annualized, discounted cost according to standard economic practices. Although the SBEIS did not identify a disproportionate impact on small business, the department presumed that there would be such an impact and took steps to mitigate that impact in accordance with the Regulatory Fairness Act. These issues are discussed in further detail in the CES narrative.

5. *The department's SBEIS projects a cost of \$0.39 per employee (5 minutes) to determine if the rule applies to that employee or not. This 5 minutes at \$0.39 equates to a cost rate of \$4.68 per hour. Clearly, this estimate is inadequate and fails to meet the requirements of the state's Regulatory Fairness Act.*

See above response. Also, the CES narrative explains that representative sampling is acceptable for job analysis, reducing the per employee average time.

6. *The department's SBEIS states that its costs are based on the 1995 cost estimates prepared by the US DOL OSHA at that time. The US Small Business Administration did an analysis of the cost estimate prepared by the US DOL and found "...the costs of the proposed standard could be anywhere from 2.5 to 15 times higher than those estimated by OSHA...."*

The Department used cost estimates developed by OSHA where it was appropriate to do so, but did not adopt OSHA’s economic analysis as its own. The proposed OSHA rule differs significantly from L&I’s proposed ergonomics rule. The OSHA rule is triggered by WMSD injuries and contains medical management provisions. L&I’s rule is risk based and does not contain a medical management provision.

The Small Business Administration hired Policy Planning & Evaluation Inc. (PPE) to analyze OSHA’s proposed ergonomics rule. PPE made its own estimate(s) of the cost to comply with the rule and attempted to recreate OSHA’s compliance cost estimate. Comparisons were made between the PPE estimated compliance costs and the OSHA estimated cost: ratios of 2.5 to 1.0 are cited. The department has reviewed the PPE critique and has found several flaws in their analysis. The three most egregious errors in the PPE analysis are listed below:

- PPE used an incorrect base number of WMSDs in its analysis. Therefore, PPE understated OSHA’s own estimate by more than 40 percent. Correcting this error increases the estimate by 2.5 times, bringing OSHA’s estimate within PPE’s range.



- PPE analysts assumed that 1 million additional WMSDs would be reported each year following promulgation of the OSHA rule. Even to the extent it might be true, this would only affect the cost of an injury based rule like OSHA's, not a hazard based rule like L&I's. . Finally, the estimate suggests that valid claims have gone unreported. To the extent that is true, those costs are not the result of the rule, but of existing legal obligations, and they do not represent new costs.
- PPE analysts overestimated control costs.

OSHA conducted an extensive review of ergonomic hazard control costs and established per worker control costs for all of the SIC (3 digit level) categories to which the rule is meant to apply. Their typical per worker control cost, after netting out productivity improvements from design changes, was about \$1,000 (present value). The PPE analysts, providing no basis for their assumptions, assume that hazard control costs will range from \$5,000 to \$50,000 per worker. When faced with a choice between a number that has been developed using the best available evidence and one provided without any substantiating information, the department relied on the more credible data.

7. *The department's SBEIS (Summary Table 2) shows that the cost to comply as a percent of sales for small business is more than 3 times higher as compared to larger business in the same industry (i.e. retail trade). The "sum" cost for the average small business is 2.6 times higher as compared with larger businesses. Based on information presented above, this estimate is clearly understated by many times, and fails the intent of the state's Regulatory Fairness Act.*

The department's economic analysis is presented fully in the cost-benefit analysis and discussed in the CES narrative. The department is confident that the final cost estimates are accurate and based on the best available data.

## **Response to Comments by Northwest Food Processors Association and Snokist Growers**

The department has analyzed and responded fully to the comments by Northwest Food Processors Association and Snokist Growers. The department response may be found in four places: this response summary, cost-benefit analysis, the CES narrative and appendix d to the CES.

Seasonal industries are not recognized

The proposed rule did take into account the needs of seasonal industries in several ways and the final rule was modified in response to comments to strengthen these special provisions. The basic awareness education requirement is fully portable. Employer size is defined in the final rule as the number of FTEs rather than the number of employees as written in the proposed rule. The final rule defines typical work activities as those that are a regular and foreseeable part of the job and occur on more than one day per week and more frequently than one week per year. This was modified to make it clear that incidental or occasional exposures are not covered. Also, the rule provides considerable flexibility for employers to choose the methods they use to identify and reduce hazards. These subjects are discussed in more detail in the CES.

### *2. Science of ergonomics insufficient to justify a need for a standard.*

The comments question whether there is adequate scientific evidence to support rulemaking. The department has evaluated the scientific evidence and concluded that it is sufficient. This is discussed in detail in the CES.

### *3. Too far-reaching*

The comments indicate that almost every job in food processing plants would be classified as “caution zone.” The department believes that this is an overstatement, particularly with the clarifications in the final rule that ensure that jobs with incidental exposures are not covered. However, even if a large proportion of jobs were covered this would be appropriate because the rule is designed to cover only those jobs that are sufficiently dangerous to warrant caution or control.

The comments state that the rule will give the State the power to decide virtually every aspect of private business. This is not true. The rule requires that employers identify and reduce exposure to hazards but it does not prescribe how to do this. The rule provides employers with substantial flexibility and choices. This is discussed in detail in the CES.

### *4. Current safety programs are effective at reducing injuries*

The comments state that rules are unnecessary because progress has been made without them. The department agrees that progress has been made as a result of more than ten years of voluntary efforts. However the department also believes that this has not and will not be sufficient. While the rate of all workers’ compensation claims has been declining during the 1990’s the rate for WMSDs has declined more slowly and the proportion of all claims

represented by WMSDs has increased. Moreover, the rate of decline in WMSDs has slowed considerably in the past few years and in several important industry groups and for some types of WMSDs the rates have flattened completely or actually increased. This is discussed in detail in the CES.

It is not true that the department's statistics ignore self-insured employers. The data used by the department for this rulemaking are discussed in detail in the CES and other documents in the record.

*5. Compliance costs far outweigh benefits*

The department has evaluated the concerns expressed in these comments and disagrees. The department's full reasoning is presented in the cost-benefit analysis and the CES. The comments appear to fail to note the following: The costs are averaged over all businesses within a business category, not just those with large numbers or percentages of hazardous jobs; the costs take into account a lengthy phase-in period and are discounted to present value dollars; the costs are averaged annually for all employees with a business category; and the costs are annualized over several years depending on the rule component.

The rule does not require employers to be as effective as the "best practices" of national organizations. The rule does not require job analyses of "virtually all jobs in manufacturing in the state." These points are discussed in the CES.

The department has reviewed the cost benefit analysis of the federal OSHA proposal prepared by Prime Consulting for the Food Distributors International. The OSHA proposal is substantially different from this rule and it would be inappropriate to generalize the conclusions from OSHA to WISHA even if the analysis was properly done. However, L&I believes the Prime analysis is based on extreme and unsupportable assumptions about the numbers of employees affected, the costs of training and the costs of engineering controls. For example, the Prime analysis makes the assumption that poor posture, poor physical conditioning, the aging process and prior off the job injuries will have a huge economic impact. Even if this were true for the OSHA proposal it is not true for the WISHA rule. The L&I cost-benefit analysis is based on the best available evidence and a correct set of assumptions about the actual requirements of the rule.

The Snokist analysis makes the presumption that the workforce will have to be increased fourfold to comply with the rules. This is not true. The final rule states that an employer is not required to replace full-time with part-time employees or to otherwise reduce an individual's employment hours to be in compliance. This is discussed in the CES.

The department has reviewed the Snokist list entitled "5 year capital for ergonomics." While this employer may have made good decisions for reducing injuries or increasing efficiency, it is evident that many, perhaps most, of the activities and expenses would not have been required by the rule. More than \$1 million was spent on equipment that reduced the number of employees doing repetitive work, but the rule does not require an employer to do this to be in compliance. Also, most of the examples indicate that certain activities have been eliminated by purchase of equipment. The rule only requires that exposures be reduced, not eliminated and the documents

APPENDIX D2:  
SELECTED RESPONSES

submitted do not have enough detail to determine the cost for reducing exposures below hazardous levels. The documents do not have enough detail to determine whether the jobs described were above hazardous levels to begin with.

6. *Work related vs. unrelated*

The comments state that the rule places a burden of proof on the employer for injuries that are unrelated to the workplace. This is not true. The rule requires only that employers address specified physical risk factors in the workplace. This is discussed in detail in the CES.

7. *The department rejected industry alternatives*

It is true that the department has rejected industry requests to set the rule aside and to pursue a variety of non-regulatory alternatives. The department's analysis and conclusions about alternatives is discussed in detail in the CES narrative, CES Appendix E and other materials in the record.

## **Response to Association of Washington Cities**

The department has analyzed and responded fully to the comments by the Association of Washington Cities. The department response may be found in four places: this response summary, cost-benefit analysis, the CES narrative and the appendices to the CES.

### *1. Caution Zone Standards Apply to Almost Every Job*

The criteria for caution zone jobs have been clarified in the final rule to address the concerns expressed. For example, typical work activities have been more clearly defined as those that are a regular and foreseeable part of the job and occur on more than one day per week and more frequently than one week per year. This ensures that many occasional and incidental activities will not be inadvertently covered. Also, the final rule that gripping an object weighing 10 or more pounds applies to unsupported objects only. This clarifies that simply holding a vehicle steering wheel does not meet the caution zone criteria. As another example, working with the neck or back bent means postures that are assumed without support and without the ability to vary posture. This clarification clarifies the limited scope of the criteria, as the department intended.

### *2. Delayed Implementation*

The department has considered the request for additional implementation. The final rule has been modified to provide an additional nine months before initial compliance with basic employee education requirements. The implementation schedule is discussed in detail in the CES.

### *3. Clarification needed*

This rule does not supercede or otherwise change the Washington State workers' compensation system. Compliance with this rule and the existence or absence of caution zone jobs or hazardous jobs will not be used as the basis for accepting or rejecting a workers' compensation claim. L&I will continue to adjudicate claims based on the legal definitions of workplace injury and occupational disease as reflected in the statute and interpreted by the courts.

### *4. Federal/State Rules Coordination*

The department intends to coordinate its activities with federal OSHA. It will also clarify the relationship of the ergonomics rule with the enforcement of other WISHA rules as requested in the comments. This is discussed in more detail in the CES.

### *5. Safe Harbor Protections*

The comments request that the department provide safe harbor protections for employers who act in good faith. L&I has decided to reject this suggestion. The effectiveness of employee protection should be measured against the employer's actual performance in reducing hazards, not the employer's intent. Also, the "good faith" formulation would

require an inquiry into the employer's state of mind and not an objective inquiry into whether the program was effective or reasonable. Moreover, a good faith test would render the rule less protective than the existing general duty of employers to use all feasible controls to keep workplaces free from recognized hazards. Under the existing safeplace standard (WAC 296.24.073) employers must do everything that is reasonably adequate and necessary to control recognized hazards. "Good faith" might not result in reasonably adequate and necessary controls. This issue is discussed in more detail in the CES.

6. *Technical Assistance is Essential*

The department believes that the comments overstate the need for technical expertise for compliance with the rule. The department believes that the resources necessary to understand, prepare for and comply with the rule are well within the resources of small employers, including those in the public sector. These matters are discussed in detail in the CES and the cost-benefit analysis.